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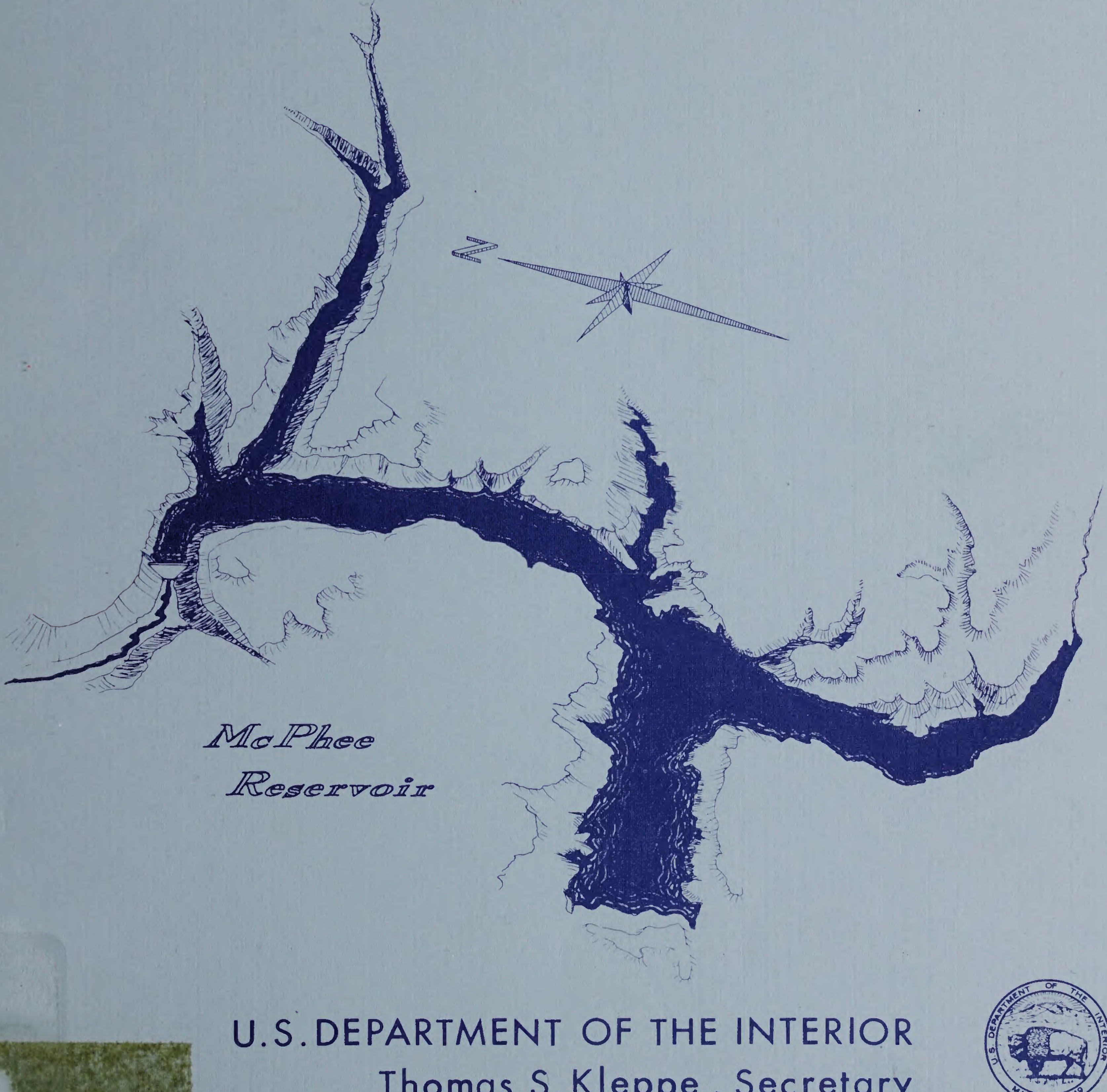

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ENVIRONMENTAL STATEMENT

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DOLORES PROJECT
COLORADO

Prepared by

Upper Colorado Regional Office, Salt Lake City, Utah
Bureau of Reclamation
Department of the Interior

NOV 1 1976

David L Crandall
David L. Crandall
Regional Director

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SUMMARY

(X) Draft ( ) Final Environmental Statement

Department of the Interior, Bureau of Reclamation, Upper Colorado Region

1. Type of action: (X) Administrative ( ) Legislative

2. Description of proposal: The Dolores Project would be located in Montezuma and Dolores Counties in southwest Colorado. It would involve the diversion of water from the Dolores to the San Juan River Basin. The project would include McPhee Reservoir on the Dolores River, the smaller Monument Creek and Dawson Draw Reservoirs in the San Juan River Basin, and two major conveyance systems. An average of 126,600 acre-feet of water annually would be developed for the irrigation of 26,300 acres of supplemental service land and 35,360 acres of full service land, for municipal and industrial use, and for fish and wildlife enhancement. Part of the water would be provided for the Ute Mountain Ute Indian Reservation. The project would include recreational facilities and acquisition and development of land for wildlife. Snowmelt floods on the Dolores River would be controlled. A 9-year construction period is anticipated.

3. Summary of environmental impacts and unavoidable adverse effects: Agricultural production would be increased, as would farm and farm-related incomes. Social conditions and long-term growth trends would be essentially unchanged. Forty-five families in McPhee Reservoir basin would be relocated, necessitating some social adjustments.

   Average annual flows in the Dolores River would be reduced by 105,200 acre-feet. Flows in the San Juan River would be increased by about 24,300 acre-feet, resulting in a net decrease of 80,900 acre-feet in the Colorado River. Over 100 years salinity in the lower Colorado River at Imperial Dam would be increased by an average of 8.4 mg/l from stream depletions and 1 mg/l from salt loading. The water quality in the San Juan and Colorado Rivers would not be significantly affected by increased uses of pesticides and fertilizers.

   About 15½ miles of poor game fish habitat would be flooded. New trout fisheries would be provided in project reservoirs and in the Dolores River below McPhee Reservoir. Also trout fisheries would be improved in existing reservoirs and in streams above McPhee Reservoir. Wildlife habitat would be reduced by the inundation of about 4,850 acres, the use of 670 acres for project structures, and the conversion of 7,500 acres of uncultivated land to irrigation. These losses would be largely compensated for by acquisition and development of land for wildlife management and plantings along canals.

   Opportunities for white-water boating in the Dolores River would be increased. Additional recreational opportunities would be provided along the river and at project reservoirs. The river's appeal as a wild and scenic river would be increased.

   The natural setting would be intruded upon by man-made structures and some exposed foreshores. Most material sources would be inundated. About 460 archaeological sites would be disturbed.

4. Alternatives considered:
    1. Four modifications of plan.
    2. Four alternative uses of water.
    3. Nondevelopment.

5. Statements are being distributed to the following: See list on next page.

6. Date draft statement made available to C.E.Q. and the public: NOV 1 1976

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Ute Mountain Ute Indian Tribal Council, Towoac, Colo.
Upper Colorado River Commission, Salt Lake City, Utah
Colorado River Board of California, Los Angeles, Calif.
Southwestern Water Conservation District, Durango, Colo.
Dolores Water Conservancy District, Cortez, Colo.
Montezuma Valley Irrigation Company, Cortez, Colo.
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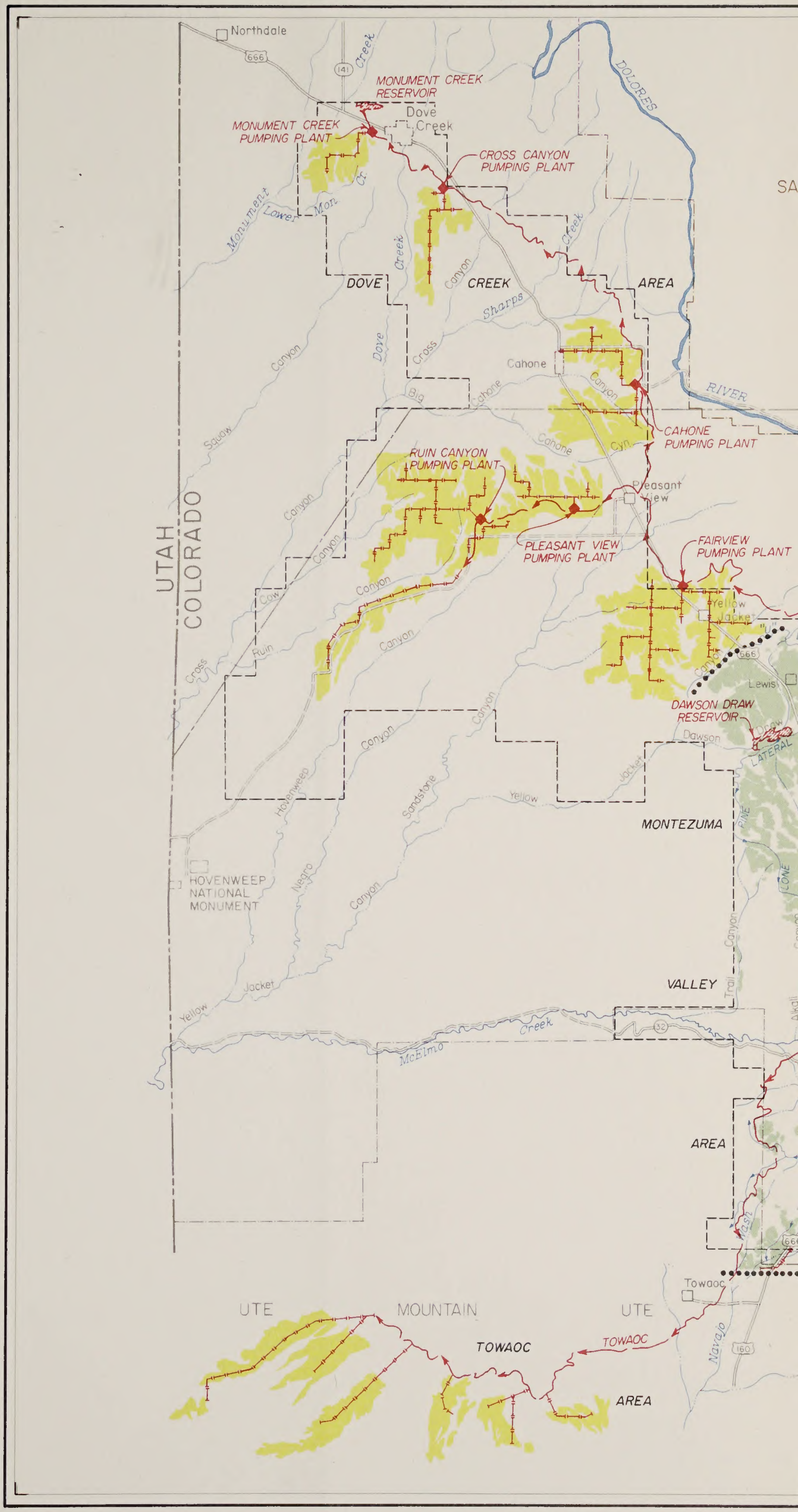
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MONUMENT CREEK
RESERVOIR
Dove
Creek
MONUMENT CREEK
PUMPING PLANT
CROSS CANYON
PUMPING PLANT
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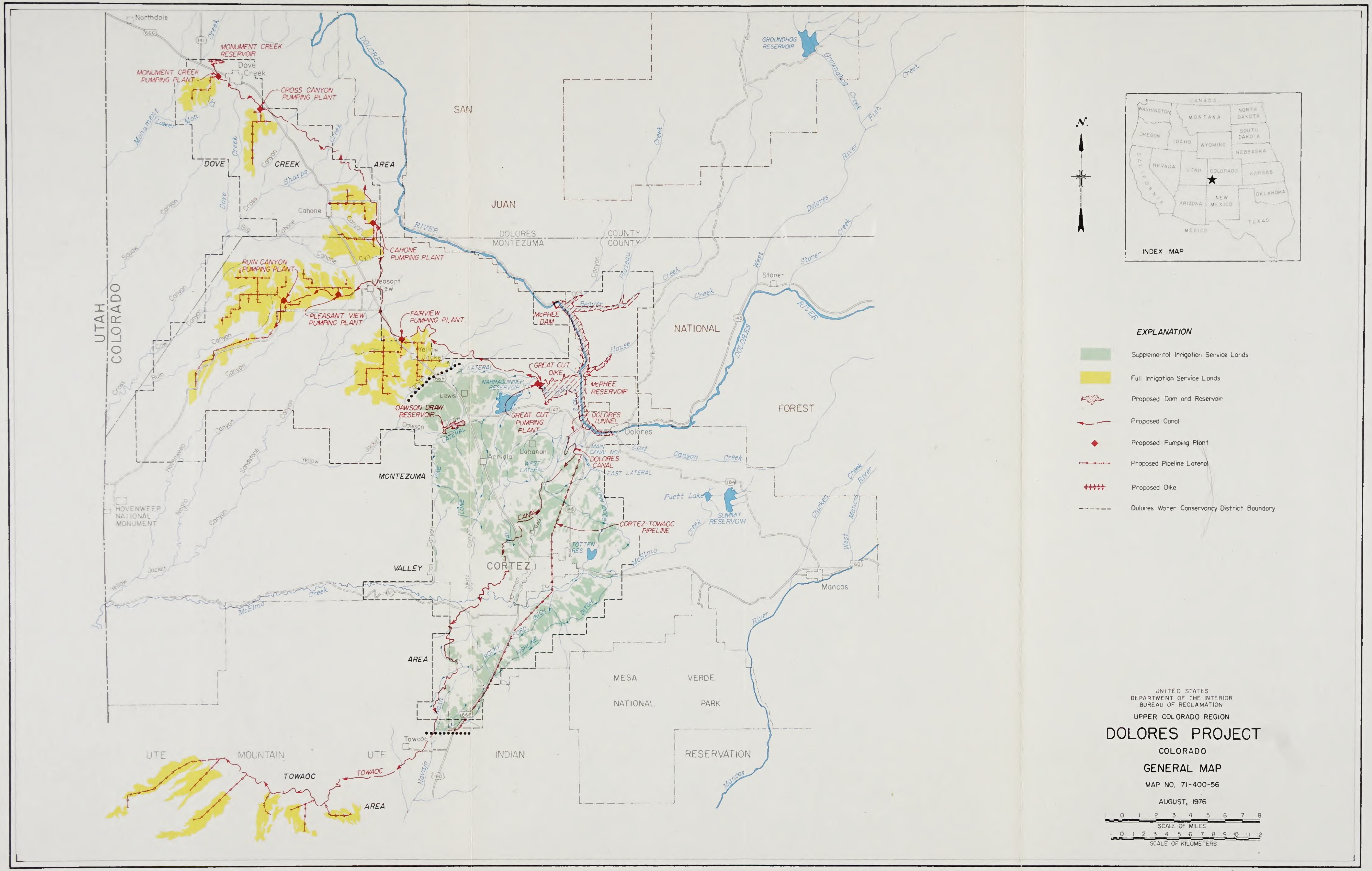


EXPLANATION

🟩	Supplemental Irrigation Service Lands
🟨	Full Irrigation Service Lands
▨	Proposed Dam and Reservoir
←	Proposed Canal
◆	Proposed Pumping Plant
⊢⊢⊢	Proposed Pipeline Lateral
┼┼┼┼┼	Proposed Dike
– – – –	Dolores Water Conservancy District Boundary

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
UPPER COLORADO REGION

DOLORES PROJECT

COLORADO

GENERAL MAP

MAP NO. 71-400-56

AUGUST, 1976

CHAPTER A

DESCRIPTION OF THE PROPOSAL

A. DESCRIPTION OF THE PROPOSAL

1. Introduction

This environmental statement has been prepared in compliance with Section 102(2)(C) of the National Environmental Policy Act (NEPA) of 1969, Public Law 91-190. The Dolores Project was authorized for construction by the Colorado River Basin Act of September 30, 1968 (Public Law 90-537) as a participating project of the Colorado River Storage Project. The project would commit to beneficial uses part of the streamflows allocated to Colorado by the Colorado River Compact of 1922 and the Upper Colorado River Basin Compact of 1948.

The Dolores Water Conservancy District and the Ute Mountain Ute Indian Tribe sponsor and actively support the Dolores Project. The proposed plan is the result of the cooperative endeavors of the Bureau of Reclamation, the sponsoring organizations, and a number of Federal, State, and local agencies. The Montezuma Valley Irrigation Company, which has undertaken most of the water resource development in the area to date, also supports project development.

2. Location

The Dolores Project area (shown on the general map) lies within Montezuma and Dolores Counties of southwestern Colorado, just east of the Colorado-Utah State line and north of the New Mexico-Colorado State line. The project would involve two adjacent river systems within the Upper Colorado River Basin. The Dolores River crosses the northeastern corner of the area and would provide the project water supply. Most of the water, however, would be diverted for use in the San Juan River Basin.

The project area consists of three service areas--Dove Creek, Montezuma Valley, and Towaoc. The Dove Creek area is located in the northwestern part of the project area in the vicinity of the town of Dove Creek, the seat of Dolores County. Located in the central part of the project area, the Montezuma Valley area is centered around the city of Cortez, the seat of Montezuma County. Both the Dove Creek and Montezuma Valley areas are within the Dolores Water Conservancy District. The Towaoc area is located in the southern part of the project area and is part of the Ute Mountain Ute Indian Reservation. It is named for the town of Towaoc, the tribal headquarters for the reservation.

3. Interrelationship With Other Projects and Units

The Dolores Project would be interrelated with the existing development of the Montezuma Valley Irrigation Company (MVIC) in the Montezuma Valley area. Availability of water for project development is dependent on an agreement presently being negotiated between the irrigation company and the Dolores Water Conservancy District. Essentially, the agreement would provide that the company would not significantly expand its agricultural uses of water under existing rights. Project water and existing supplies of the irrigation company would be intermingled and conveyed in project and existing facilities. It is anticipated that existing reservoirs operated by the MVIC would also be coordinated in operation with project reservoirs to permit their stabilization for the benefit of fisheries and recreation, but no formal commitments for such operation would be obtained. At the request of the irrigation company no lateral and drainage facilities are planned for the Montezuma Valley area, although such facilities are planned for other portions of the project area.

The Dolores Project would also be interrelated with other proposals. These include the Paradox Valley and McElmo Creek units of the Colorado River Basin Salinity Control Project of 1974 (Public Law 93-320) and the Dolores River Wild and Scenic Rivers Study.

To control salinity levels in the lower main stem of the Colorado River, Congress has authorized the construction of four units, including Paradox Valley, and the planning of sixteen other units, including McElmo Creek. The Dolores River flows through Paradox Valley about 110 miles downstream from McPhee Dam picking up approximately 200,000 tons of salt annually from an influx of saline ground water. Studies are now underway to select a method to remove up to 80 percent of this salt. McElmo Creek drains a portion of the return flows from the irrigated lands of the MVIC. Several methods are being studied for reducing the estimated 150,000 tons of salt that McElmo Creek annually contributes to the San Juan River.

Portions of the Dolores River have been studied for possible inclusion in the National Wild and Scenic Rivers System (Public Laws 90-542 and 93-621). In the authorizing legislation for the study, the McPhee Reservoir site and Paradox Valley were specifically excluded from consideration. The studies were based upon the assumption that McPhee Reservoir would be constructed. In December 1975 the Departments of Agriculture and Interior and the State of Colorado published a draft report recommending that the segment of the river extending from 1.3 miles below the McPhee Dam site to 1 mile upstream from the bridge near Bedrock (a total of 105 miles) be included in the system because of its wild, scenic, and recreational qualities.[1/] The State of Colorado recommended that Congress should also include the West Dolores River when it makes a final determination. An 8-mile stretch from Gateway, Colorado, to the Utah-Colorado State line was not recommended for inclusion until a study of the portion of the river in Utah was completed. The report emphasized that the Dolores Project is compatible with designating segments of the river as part of the National Wild and Scenic River System.

[1/] Colorado Department of Natural Resources, U.S. Department of Agriculture, and U.S. Department of the Interior, Dolores River: Wild and Scenic River Study Report (December 1975).

4. Project Purposes

The project would store and regulate the flows of the Dolores River to meet the present and future needs of the project area, developing usable water supplies of 90,900 acre-feet for irrigation, 8,700 acre-feet for municipal and industrial use, and 27,000 acre-feet for fish and wildlife enhancement. The project would also provide recreational facilities, aid in flood control, and contribute to economic development. Table A-1 contains a detailed breakdown of the project water allocations.

Table A-1
Water allocation

	Average annual water supply (acre-feet)	Land area (acres)
Irrigation		
Full service		
Dove Creek area	54,300	27,860
Towaoc area	22,900	7,500
Supplemental service		
Montezuma Valley area	13,700	26,300
Subtotal	90,900	61,660
Municipal and industrial use		
Dolores Water Conservancy District		
Cortez	6,200	
Dove Creek	600	
Rural areas	900	
Towaoc Indian area	1,000	
Subtotal	8,700	
Fish and wildlife use		
Released to Dolores River	25,400	
Reserved for future use		
Dolores Water Conservancy District	800	
Ute Mountain Ute Indian Tribe	800	
Subtotal	27,000	
Total	126,600	61,660

Throughout the project area the project irrigation supplies are expected to be used primarily for production of feed crops such as alfalfa and corn silage in support of general beef and dairy enterprises. In the Montezuma Valley area the project water would supplement existing supplies provided by the MVIC and would be used for improvement of existing crop yields and expansion of present livestock operations. In the Dove Creek and Towaoc areas, however, the project supplies would be used for new irrigation. Lands in the Towaoc area would be brought under cultivation for the first time. Lands in the Dove Creek area would be changed to production of feed crops from present dry farm operations for the production of pinto beans and wheat.

Lands in the Towaoc area are expected to be operated as a single enterprise by the Ute Mountain Ute Indian Tribe. It is anticipated that project water would be sold to about 500 of the 769 existing landowners in the Montezuma Valley area and to all of about 140 existing landowners in the Dove Creek area. Under project authorization project water could be delivered to farm units with the equivalent of 160 acres of class 1 land in single ownership, which has been determined to be 220 acres of class 2 land in the Dove Creek area and 220 acres of class 2 land and 234 acres of class 3 land in the Montezuma Valley area. No landowners in the Montezuma Valley area have land in excess of the allowable limit to which project water could be furnished under joint ownership. Five units in the Dove Creek area, however, have a total of about 2,970 acres of land in excess of the limits. It is anticipated these five landowners would dispose of their excess lands to private individuals, either by family division or outright sales. As a result, a small number of new units could be formed as subdivisions are made to meet the acreage limitation.

The municipal and industrial water supplies are planned to meet projected needs of the project area until about 2030. Some of the supply would be utilized as soon as it became available and the remainder gradually put to use as the needs developed. The supply is expected to be distributed approximately as shown in Table A-1. Distribution of the supply would be flexible, however, and within broad limits water could be shifted from one area to another if the needs did not develop as anticipated.

Most of the water provided for fish and wildlife would be used to maintain a fishery in the Dolores River. Some would be reserved for future fish and wildlife uses to be determined by the Dolores Water Conservancy District and the Ute Mountain Ute Indian Tribe.

5. Project Plan

a. Storage Reservoirs

Project storage would be provided at three reservoirs. The primary storage would be at McPhee Reservoir on the Dolores River near the eastern edge of the project area and 15 miles directly north of Cortez. The reservoir would be formed by McPhee Dam, to be constructed on the river about 10 miles downstream from the town of Dolores, and by Great Cut Dike, to be constructed in a saddle west of the river on the Dolores-San Juan Divide about 5 miles upstream from the dam. The lower portion of the reservoir would be on land presently in the San Juan National Forest, and the upper portion would be on land now in private ownership. With project development, however, it is anticipated that the forest boundary would be extended to include the entire reservoir area.

McPhee Reservoir would be the key feature of the project and would serve all project purposes. The other two reservoirs, comparatively small in size, would be Monument Creek Reservoir on an intermittent stream about 1 mile northwest of the town of Dove Creek and Dawson Draw Reservoir on Dawson Draw near U.S. Highway 160 about 9 miles north of Cortez. Monument Creek Reservoir would regulate the municipal and industrial supply for Dove Creek and nearby rural areas and provide water for recreation and fish and wildlife purposes. Dawson Draw Reservoir would be constructed specifically to enhance the area's fish and wildlife resource and would not supply irrigation or municipal and industrial water. Both Monument Creek and Dawson Draw Reservoirs would be constructed on lands now in private ownership that would be acquired for the project.

b. Water Distribution

Water from McPhee Reservoir would be released at three points--at multiple-level outlet works in McPhee Dam, at Great Cut Dike, and at the Dolores Tunnel which would be bored through the Dolores-San Juan Divide at the upper end of the reservoir to replace an existing tunnel of the MVIC that would be plugged and abandoned. Releases from the outlet works of the dam would be made to the Dolores River, while releases through the tunnel and dike would be conveyed to the San Juan Basin. Irrigation water supplies would be delivered to farm headgates. Pressure would be provided for sprinkler irrigation on the farms in the Dove Creek and Towaoc areas, but existing gravity systems would continue to be used in the Montezuma Valley area. Municipal and industrial water supplies would be delivered by the project areas of use, and local entities would be responsible for treating and distributing the water.

(1) Downstream Releases

Releases from McPhee Reservoir to the Dolores River would be made to meet existing rights, to provide a stream fishery, and to improve opportunities for white-water boating. The releases for white-water boating would be provided on a scheduled basis when snowmelt floods were predicted in order to provide storage space for the floodflows.

(2) Releases Through Great Cut Dike

Releases from McPhee Reservoir through Great Cut Dike would be made to the project Dove Creek Canal and its branch the South Canal and to two existing MVIC facilities--Main Canal No. 2 and "U" Lateral. The Great Cut Pumping Plant would be constructed at the dike to lift water to the Dove Creek Canal and to the "U" Lateral at those times when the water level in the reservoir was too low to allow the lateral to be gravity fed. Main Canal No. 2 would be gravity fed at all times.

Water releases at the dike into Main Canal No. 2 and the "U" Lateral would be conveyed to presently irrigated lands in the northern and western portions of the Montezuma Valley area. Releases to the Dove Creek Canal would be conveyed northwestward for irrigation in the Dove Creek area and for delivery to Monument Creek Reservoir for regulation for municipal and industrial use in the area. Irrigation water would be turned out along the Dolores Canal to four lateral systems--the Fairview, Cahone, Cross Canyon, and Monument Creek. Irrigation releases also would be made to the South Canal, which would branch southwest from the Dove Creek Canal and in turn provide water to three lateral systems--the Pleasant View, Ruin Canyon, and Hovenweep. The lateral systems would extend to farm units and would consist of buried pressure pipes with a pressure turnout at each farm to permit sprinkler irrigation. Pumping plants would be constructed at the heads of all of the lateral systems except the Hovenweep, which would develop sufficient pressure from the ground slope to make a pumping plant unnecessary.

(3) Releases Through Dolores Tunnel

Water diverted through the Dolores Tunnel would flow by gravity from McPhee Reservoir into the project Dolores Canal, which would consist of enlargements of sections of the MVIC's East and West Laterals. The canal would convey existing and project supplies to lands presently served by the laterals and to Hartman Draw for lands presently served from the draw. In addition the canal would convey water to two project facilities that would branch from the canal--the Towaoc Canal, which would convey project irrigation water to the Towaoc area, and the Cortez-Towaoc Pipeline, which would convey municipal and industrial water to Cortez and Towaoc.

The Towaoc Canal would convey irrigation water to five buried lateral systems that would be constructed as project features in the Towaoc area. Sufficient pressure for sprinkler irrigation would be developed in the systems from the ground slope. The water reserved for fish and wildlife uses in the Towaoc area also would be conveyed in the Towaoc Canal when uses for the water were determined.

The Cortez-Towaoc Pipeline would convey existing and project supplies to Cortez and project supplies to Towaoc. All of the supply in the pipeline would be conveyed for treatment at an existing plant of the city of Cortez or at a new plant under consideration by the Dolores Water Conservancy District, either of which would be near the canal alignment. After treatment, the water would be returned to the pipeline. Part would be turned out to Cortez, and the rest would continue on Towaoc.

c. Irrigation Scheduling

A program of irrigation scheduling would be instituted on project lands in the Dove Creek and Towaoc areas, where the pressure lateral system would permit sprinkler irrigation. The program is planned for water conservation but would also be effective in increasing agricultural production and decreasing salt contributions to the Colorado River. The program would be instituted by the Bureau of Reclamation but ultimately would be administered by the water users. Such a program is not planned for the Montezuma Valley area since present methods of farming with gravity systems are well established.

d. Drains

Project drains would be provided for the Dove Creek and Towaoc areas based on needs demonstrated during the first years of project operation. As requested by the MVIC, drains would not be provided for the Montezuma Valley area. Accordingly, the Bureau of Reclamation has excluded any drainage deficient lands in that area from project service.

e. Recreation and Fish and Wildlife Developments

Recreational facilities would be provided at McPhee, Monument Creek, and Dawson Draw Reservoirs for such diverse recreational activities as fishing, boating, camping, picnicking, or sightseeing. To help preserve the scenic nature of the landscape at McPhee Reservoir, easements would also be acquired at the reservoir as part of project development. Recreation facilities would also be constructed along the Dolores River to benefit boaters, fishermen, and others.

Land would be acquired and developed for wildlife at McPhee Reservoir to compensate for the loss of habitat resulting from the construction and operation of the reservoir. New habitat for upland game and waterfowl would be created at Dawson Draw Reservoir. New upland game habitat would also be created at Monument Creek Reservoir and along sections of project canals. Easements would be acquired along stretches of the Dolores River below McPhee Reservoir to improve access for fishermen.

6. Project Features

a. McPhee Reservoir

(1) Design Data

McPhee Dam and Great Cut Dike would be rolled, earthfill structures. At McPhee Dam, multilevel outlet works (illustrated in Figure A-1) would be constructed in the left abutment of the dam. Two intake structures would feed water through the outlet works. The river intake (a pipe through the base of the dam) could release water from the bottom of the reservoir at anytime, although it would be operated most often in the spring and early summer in anticipation of snowmelt inflow to benefit white-water boating. The second structure would be a selective intake capable of releasing water from three different reservoir levels to control the water temperature for the benefit of the fishery downstream, particularly in the late summer, fall, and winter. A gated spillway with a concrete chute leading to a stilling basin would be located on the right abutment of the dam. The spillway, acting in combination with the outlet works, would have sufficient capacity to pass the maximum probable flood without damage to the dam. The spillway and outlet works would be designed so as not to induce gas supersaturation problems in the water spilled or released to the Dolores River.

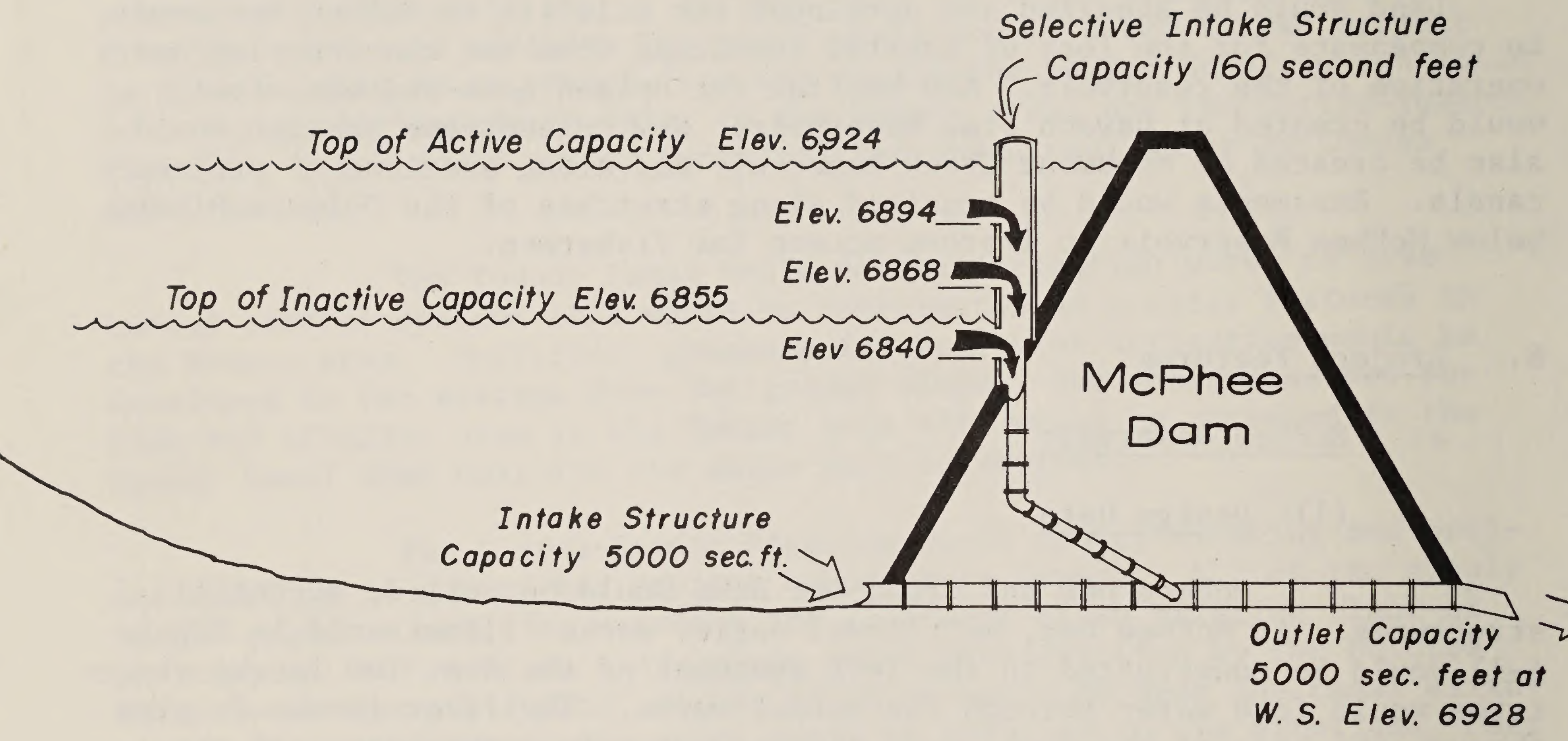


Figure A-1
McPHEE DAM
OUTLET WORKS — SCHEMATIC

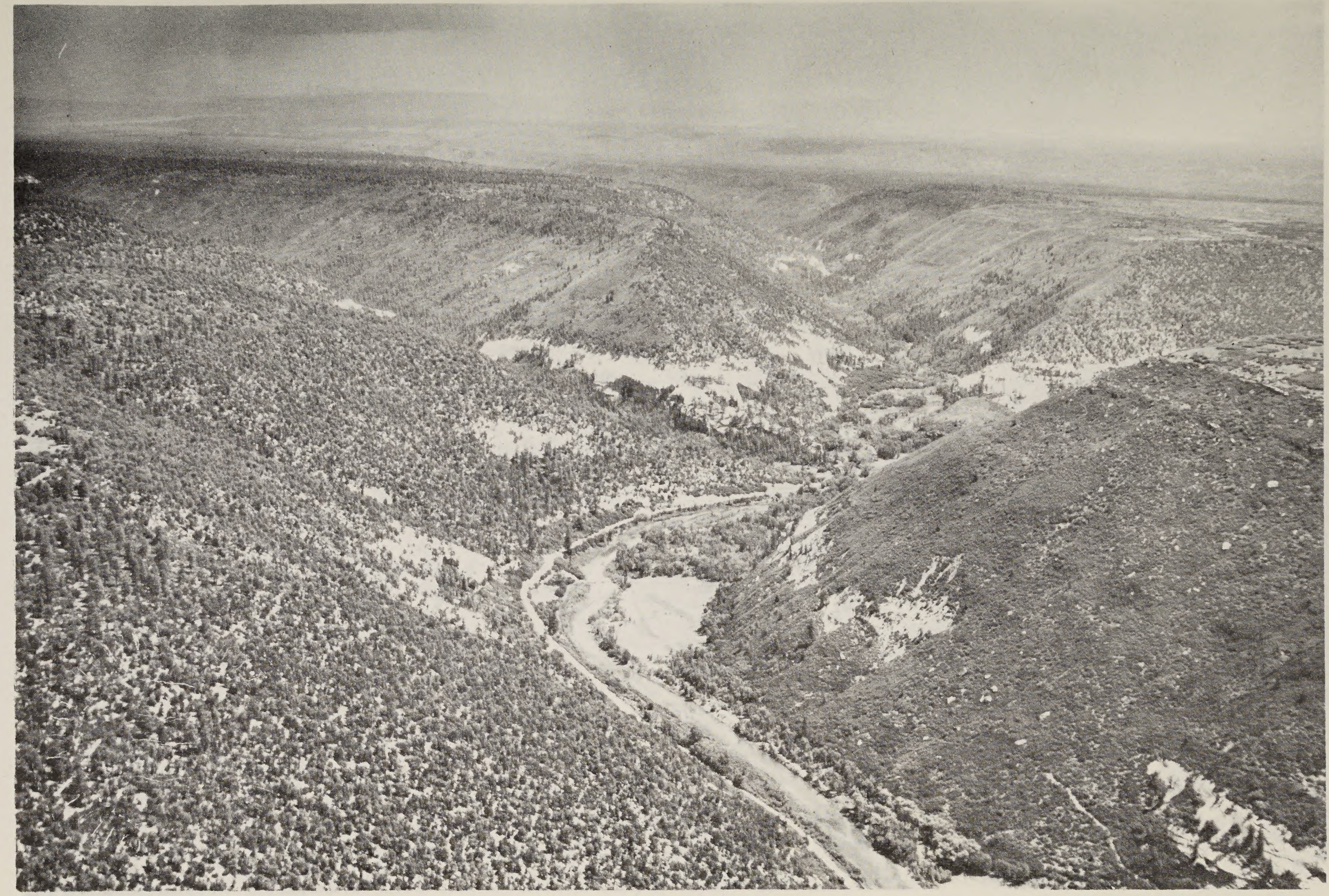


Figure A-2--Aerial view of McPhee Dam and Reservoir site on Dolores River.

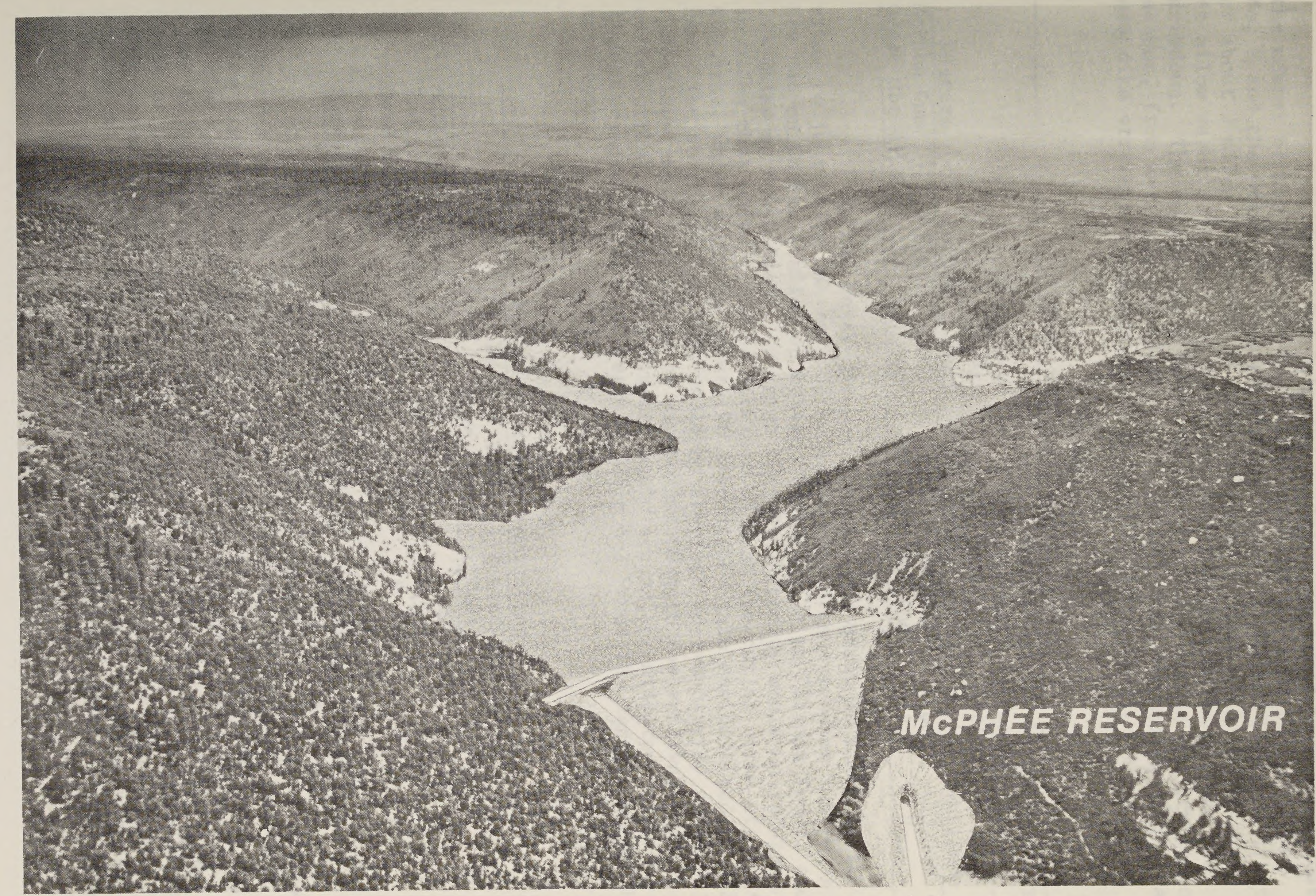


Figure A-3--Artist's conception of McPhee Dam and Reservoir.

At Great Cut Dike the outlet works would be located near the center of the structure and would regulate releases to Main Canal No. 2 and the Great Cut Pumping Plant. An inlet channel having a length of about 2 miles and a bottom width of about 20 feet would be required to allow reservoir water to reach the outlet works during periods of drawdown. The outlet works would be operated only during the irrigation season, from April to mid-October. Technical data pertaining to the dam and dike structures are presented in the following table.

Table A-2
McPhee Dam and Great Cut Dike

	Crest (feet)			Material volume unit	Discharge Capacity (second-feet)	
Feature	Height	Length	Width	(cubic yards)	Outlet works	Spillway
McPhee Dam	270	1,300	30	5,029,000	5,000	33,000
Great Cut Dike	64	1,900	30	189,000	820	None

McPhee Reservoir would extend for about 10 miles up the river to just below the town of Dolores, with arms extending 1 mile up Dry Canyon Creek, 4 miles up Beaver Creek, 1 mile up Plateau Creek, and 1.5 miles up House Creek. A large inactive capacity would be required in order that water could be diverted through the outlet works at Great Cut Dike, which would be about 196 feet higher than the riverbed at McPhee Dam. The surcharge capacity would be provided to temporarily store floodflows until they could be discharged through the spillway and outlet works. Deposited sediments would occupy an estimated volume of 11,000 acre-feet after 100 years. Table A-3 gives the capacities of the reservoir.

Table A-3
McPhee Reservoir capacities

	Capacity (acre-feet)	Elevation (feet)	Surface area (acres)
Active capacity	229,000	6,924	4,470
Inactive capacity	152,000	6,855	2,160
Dead storage	100	6,676	24
Total	381,100		
Surcharge capacity	18,200	6,928	4,600

An area at the head of the reservoir adjacent to the town of Dolores would be filled to protect the town from backwash flooding during high inflows and to prevent the occurrence of a swampy area and mud flats during low water levels in the reservoir. The fill would cover an area of about 45 acres and would contain about 462,000 cubic yards of pervious material. The area would be covered with about 24,000 cubic yards of topsoil from the reservoir basin and then landscaped. An additional 35,000 cubic yards of fill would be used to raise existing dikes along the river at the town to offer the town better flood protection than it now has.

(2) Reservoir Clearing and Relocation

Construction of McPhee Reservoir would require the clearing of about 900 acres of vegetation from the streambed to the top of the active capacity. All trees and brush measuring more than 5 feet in height or 2 inches in diameter would be uprooted or cut off at a maximum stump height of 6 inches, measured on the uphill side. All downed timber and floatable or combustible materials larger than 4 inches in diameter or longer than 5 feet would also be cleared. Merchantable timber would be beneficially used. Any other materials would be used as fish tie-downs or disposed of at the project site. Waste material would be burned in accordance with Federal, State, and local standards, and the residue would be buried. Waste could also be chipped and then buried or used for mulch in seeding operations.

The construction of the reservoir would require the relocation of 120 people presently living within the proposed reservoir right-of-way. About 64 of these people live in 24 farm homestead dwellings within the proposed reservoir basin. The remaining 56 people live in 21 homes within the land fill area at the head of the reservoir. These people would be relocated under the provisions of Public Law 91-646 of January 2, 1971, entitled, "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970."

Because the town of Dolores' sewage treatment plant is also within the proposed landfill area, project funds would be provided to purchase the plant at its replacement value. The town would be responsible for construction of a new facility.

The construction of the reservoir would entail the relocation of Forest Service and Montezuma County roads (see McPhee development map, Figure A-7). The replacements for the roads would include a 6.9-mile access road to McPhee Dam from Colorado State Highway 147 by way of Great Cut Dike, 0.9 mile of new road from McPhee Dam downstream to the existing road along the river, and 2.3 miles of new road from McPhee Dam to the existing Dry Canyon road. These roads would be constructed to current county standards and paved. In addition, 0.6 mile of new gravel access road would be provided to the inlet of the Dolores Tunnel, and about 0.3 mile of existing road to the Dolores cemetery would be raised to the elevation of the landfill over which it would pass.

A family plot, containing 23 graves, and the McPhee cemetery, containing 52 graves, would be relocated. The Dolores cemetery below the town would not be relocated, since access to the cemetery and protection from flooding would be provided. Miscellaneous relocations would include a stream gaging station, approximately 4 miles of telephone line, and 14 miles of powerline. A natural gas storage well would be capped, and 6.5 miles of 2-inch natural gas lines would be abandoned.

(3) Reservoir Operations

McPhee Reservoir project operations have been simulated on a monthly basis, using the runoff data available during the 46-year

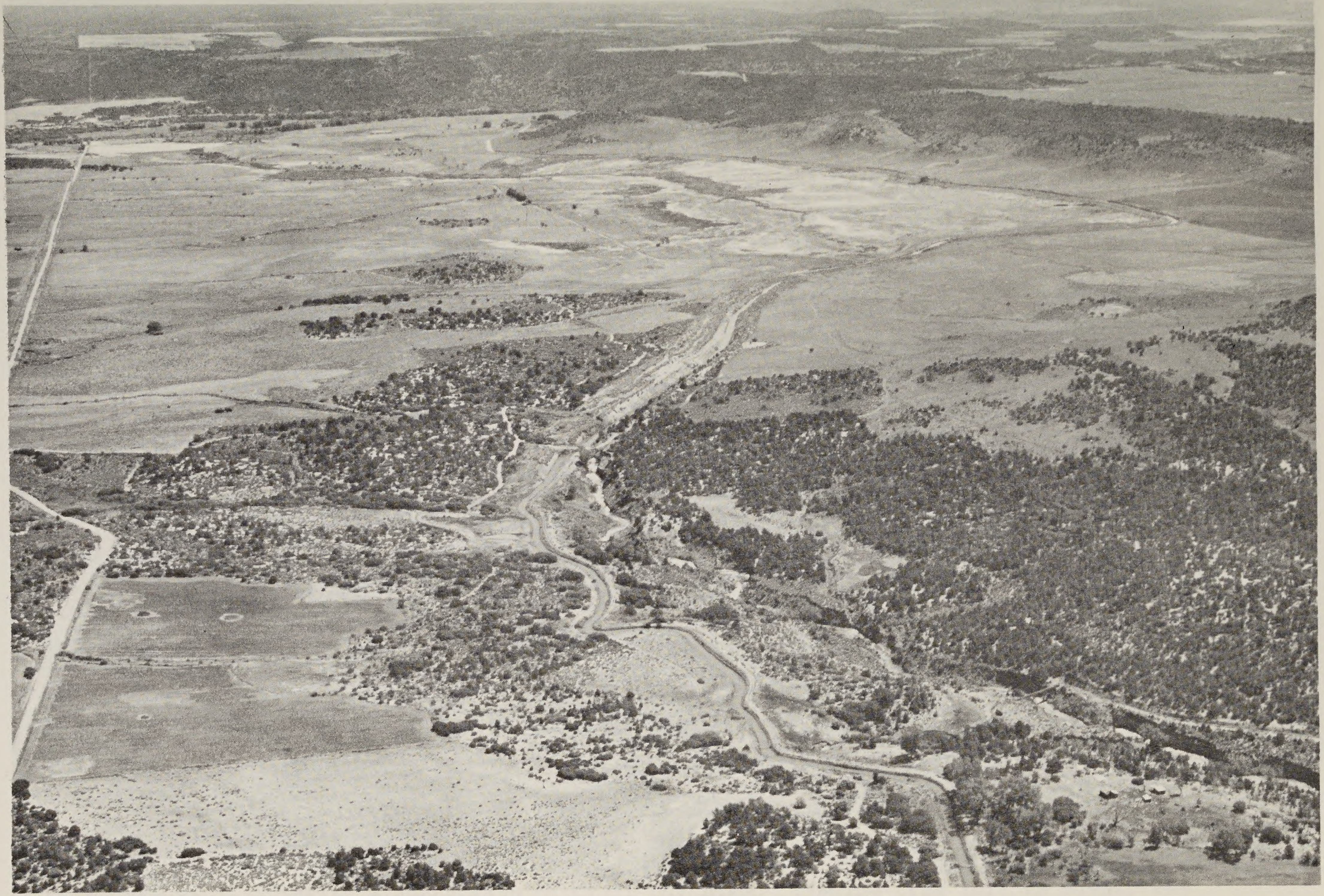


Figure A-4--Aerial view of the Great Cut Dike site.

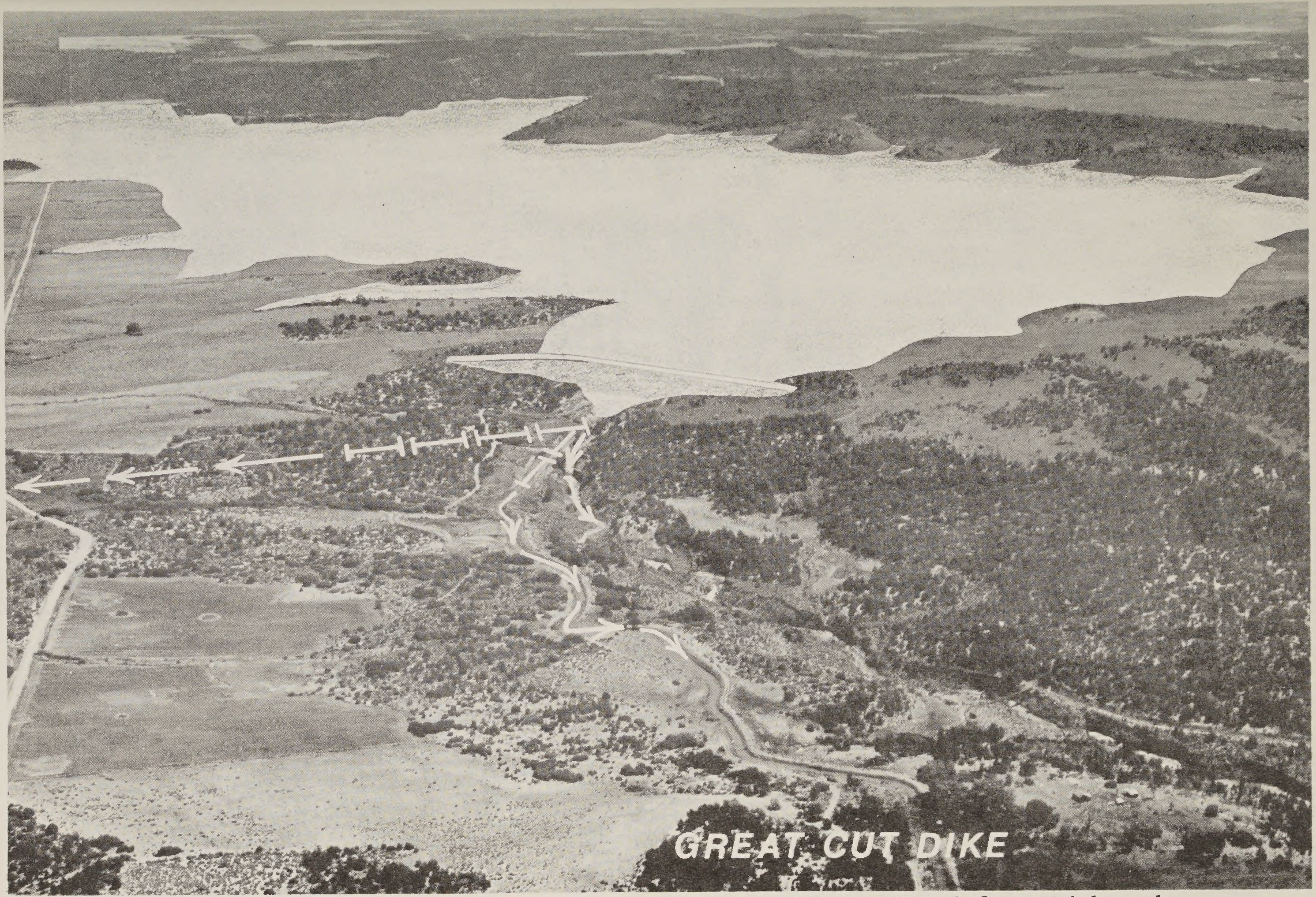


Figure A-5--Artist's conception of Great Cut Dike. Viewing from left to right, the alignment of the proposed Dove Creek Canal and the existing "U" Lateral and Main Canal No. 2 are shown leading from the dike.

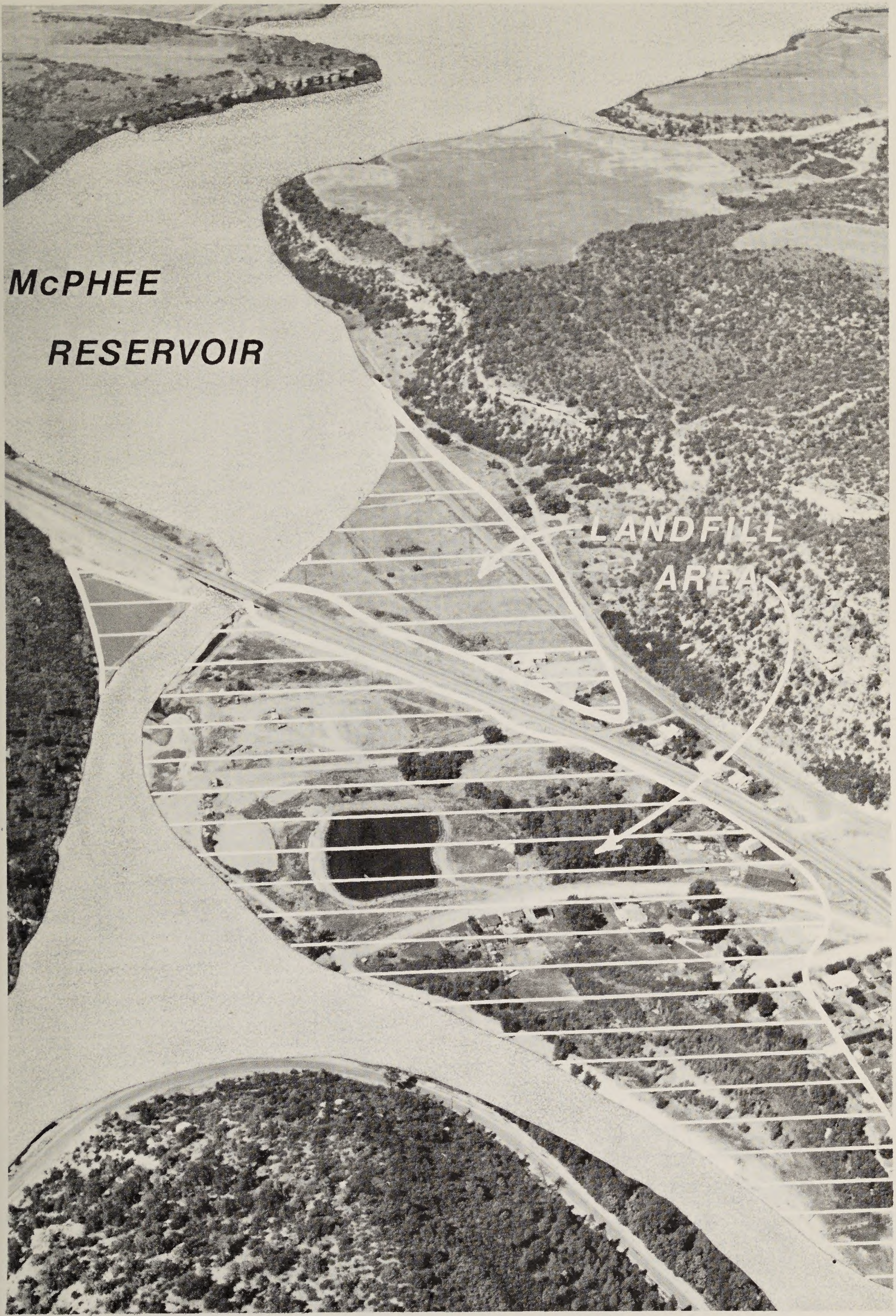
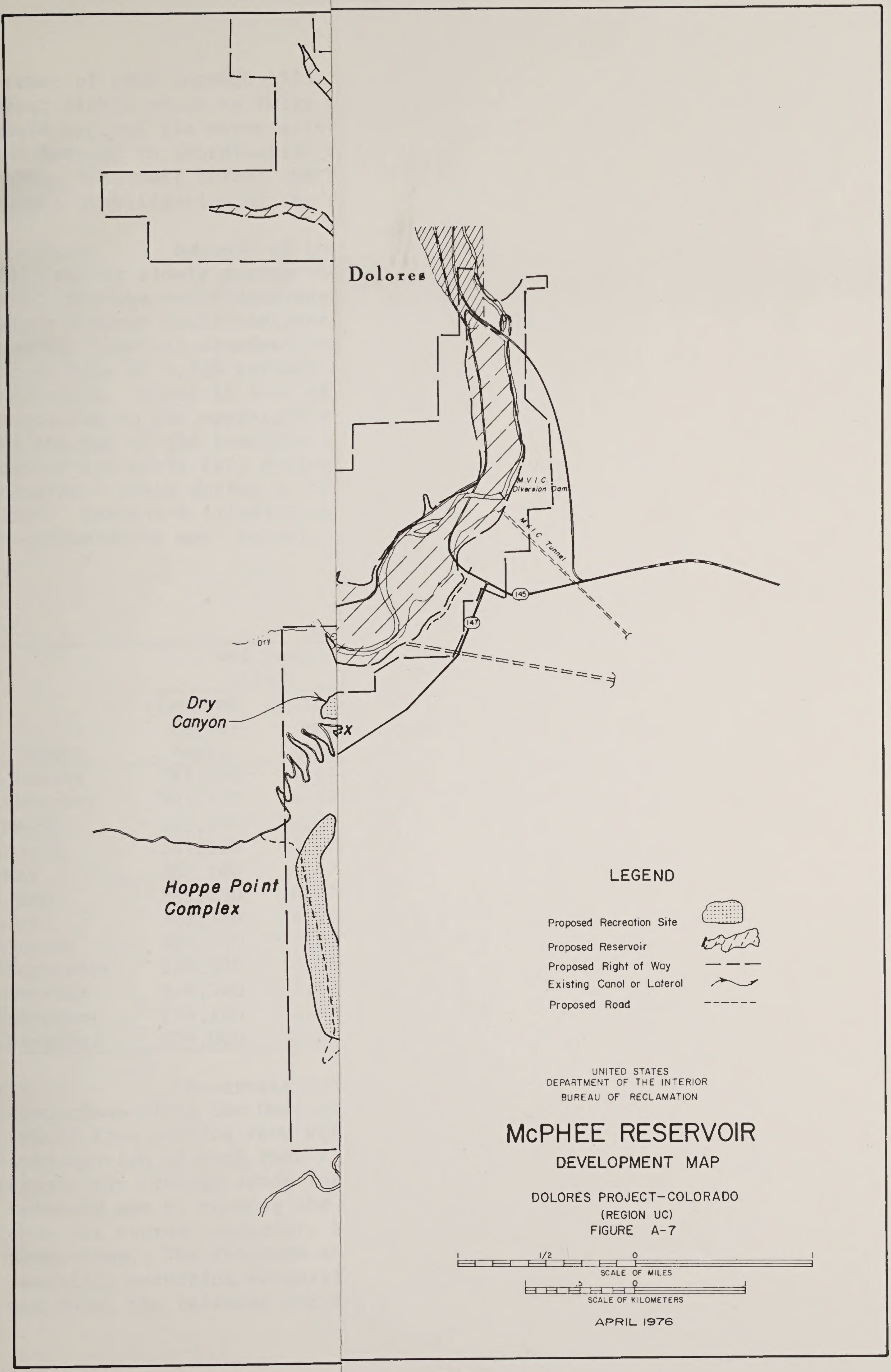


Figure A-6--Illustration showing the proposed land fill area near the town of Dolores.

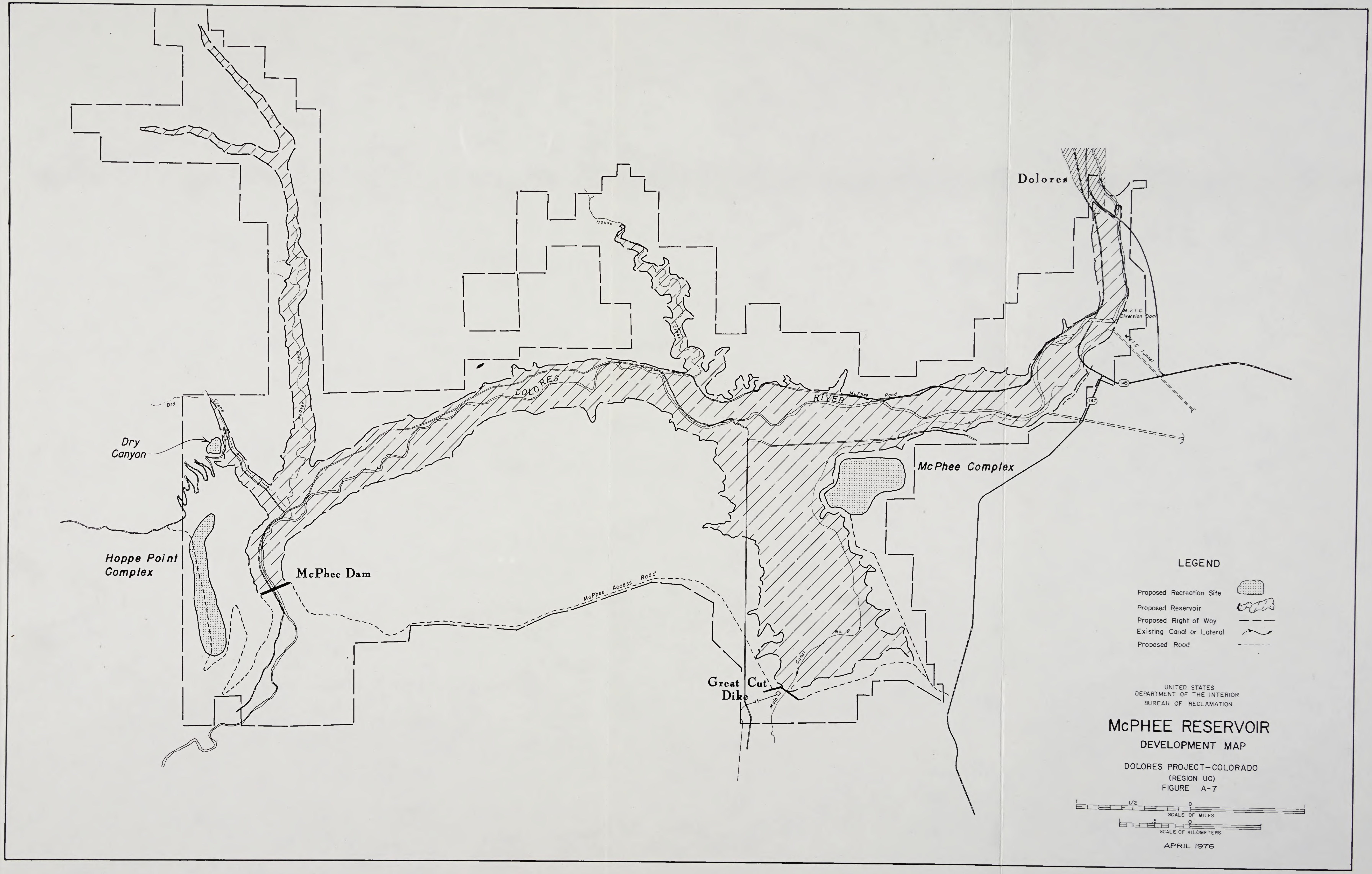


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

McPHEE RESERVOIR
DEVELOPMENT MAP

DOLORES PROJECT–COLORADO
(REGION UC)
FIGURE A-7

APRIL 1976



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

MCPHEE RESERVOIR
DEVELOPMENT MAP

DOLORES PROJECT–COLORADO
(REGION UC)
FIGURE A-7

APRIL 1976

period of 1928 through 1973. The study assumes that prior nonproject water rights would be fully supplied in each year and that the MVIC would operate its three existing reservoirs (Groundhog, Narraguinnep, and Totten) in coordination with the project. Water could be used from McPhee Reservoir before the MVIC reservoirs were drawn down in order to permit stabilization of the smaller reservoirs.

Because of the riverflow pattern, McPhee Reservoir would fill fairly slowly during the winter and more rapidly from March through May. Storage would decrease in the summer and fall when increasing water demands would contrast with sharply declining streamflows. The average seasonal drawdown would be 25 feet, reducing the water surface to an area of 3,310 surface acres and exposing about 1,160 acres of foreshore. About 12 feet of the drawdown would occur during July alone. According to the operation study, the largest drawdown would be 50 feet, to the top of the inactive capacity. This level was reached in the late summer and early fall during 8 years of the 46-year study period, including 5 years during a critical drought that lasted from 1951 through 1959. Table A-4 illustrates the reservoir content and drawdown during representative wet, normal, and dry years.

Table A-4
McPhee Reservoir
end-of-month content

	Wet year (1942)		Normal year (1962)		Dry year (1959)	
Month	Content (acre-feet)	Surface area (acres)	Content (acre-feet)	Surface area (acres)	Content (acre-feet)	Surface area (acres)
January	381,100	4,470	179,300	2,590	253,300	3,450
February	381,100	4,470	182,500	2,590	250,700	3,420
March	381,100	4,470	186,600	2,630	252,000	3,420
April	381,100	4,470	277,900	3,630	257,700	3,480
May	381,100	4,470	341,100	4,160	263,200	3,510
June	381,100	4,470	343,200	3,720	219,900	3,040
July	331,700	4,060	290,200	3,480	163,000	2,280
August	300,700	3,840	257,300	3,480	152,000	2,160
September	280,300	3,660	238,700	3,280	152,100	2,160
October	274,500	3,630	235,000	3,240	152,100	2,160
November	274,100	3,600	235,100	3,240	152,100	2,160
December	274,000	3,600	234,500	3,240	152,500	2,160

Reservoir operations would help to control flood water downstream along the Dolores River. Predictions would be made of high runoff from melting snow which might flow over the spillway, and in anticipation of such runoff controlled releases could be made to increase the storage space for control of the flows. By means of such releases and by opening the spillway gates if the floods were larger than the storage capacity, the reservoir would decrease flood damage downstream. The releases and spills would average 76,100 acre-feet annually, occurring primarily in April through July. During May, June, and July, the releases for flood control, averaging 58,000 acre-feet, would be made in a pattern conducive to white-water boating on the river. April is normally too cold for enjoyable boating.

b. Monument Creek Reservoir

(1) Design Data

Monument Creek Dam would be a rolled, earthfill structure. At the dam the outlet works would be located in the left abutment and an ungated spillway would be located in the right abutment. Acting in combination, they would protect the dam from flood inflows. The outlet works would in addition regulate releases to the water users' water treatment plant and would be operated year-round. Technical data pertaining to the dam structure are shown in Table A-5.

Table A-5
Monument Creek Dam

Crest (feet)			Material volumn	Discharge capacity (second-feet)	
Height	Length	Width	(cubic yards)	Outlet works	Spillway
43	2,850	30	152,000	55	432

The reservoir would extend about 1.2 miles up an intermittent tributary of Monument Creek. Surcharge capacity would be provided to contain flood inflows until they could be discharged over the spillway or through the outlet works. Accumulated sediments would occupy an estimated 92 acre-feet after 100 years. Capacities would be as shown below.

Table A-6
Monument Creek Reservoir capacities

	Capacity (acre-feet)	Elevation (feet)	Surface area (acres)
Active capacity	560	6,798	84
Inactive capacity	70	6,787	25
Dead storage	60	6,783	14
Total	690		
Surcharge capacity	635	6,804	133

(2) Clearing and Relocations

The construction of Monument Creek Dam and Reservoir would require no clearing and no relocation of private dwellings. Approximately a half mile of a county road in the vicinity of the reservoir site could be relocated across the dam, and an access road would be constructed to a proposed recreation area on the south shore.

(3) Reservoir Operations

Monument Creek Reservoir would receive project water from McPhee Reservoir via the Dove Creek Canal only from April through mid-October, since the canal would be operated only during the irrigation

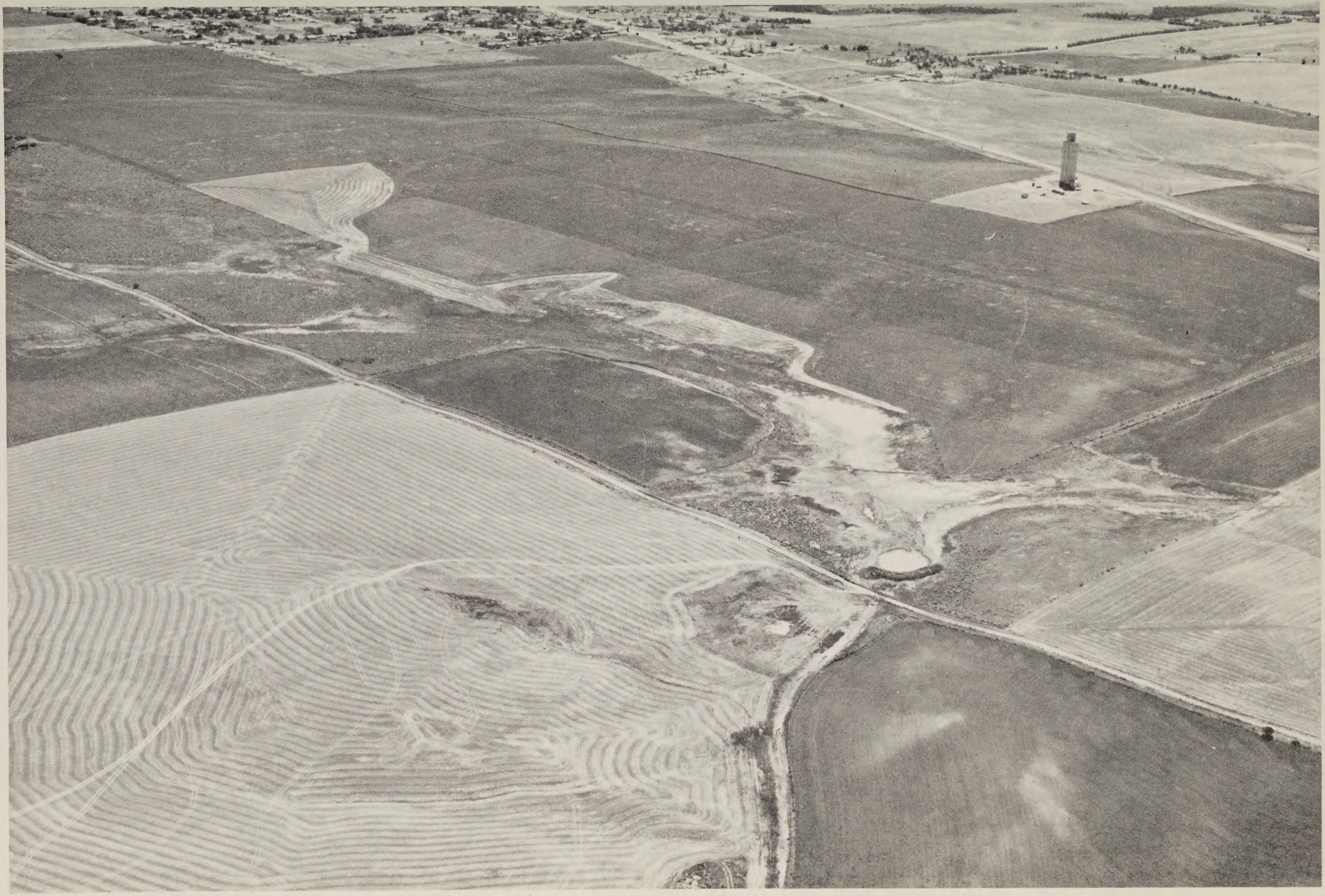


Figure A-8--Aerial view of the Monument Creek Dam and Reservoir site.

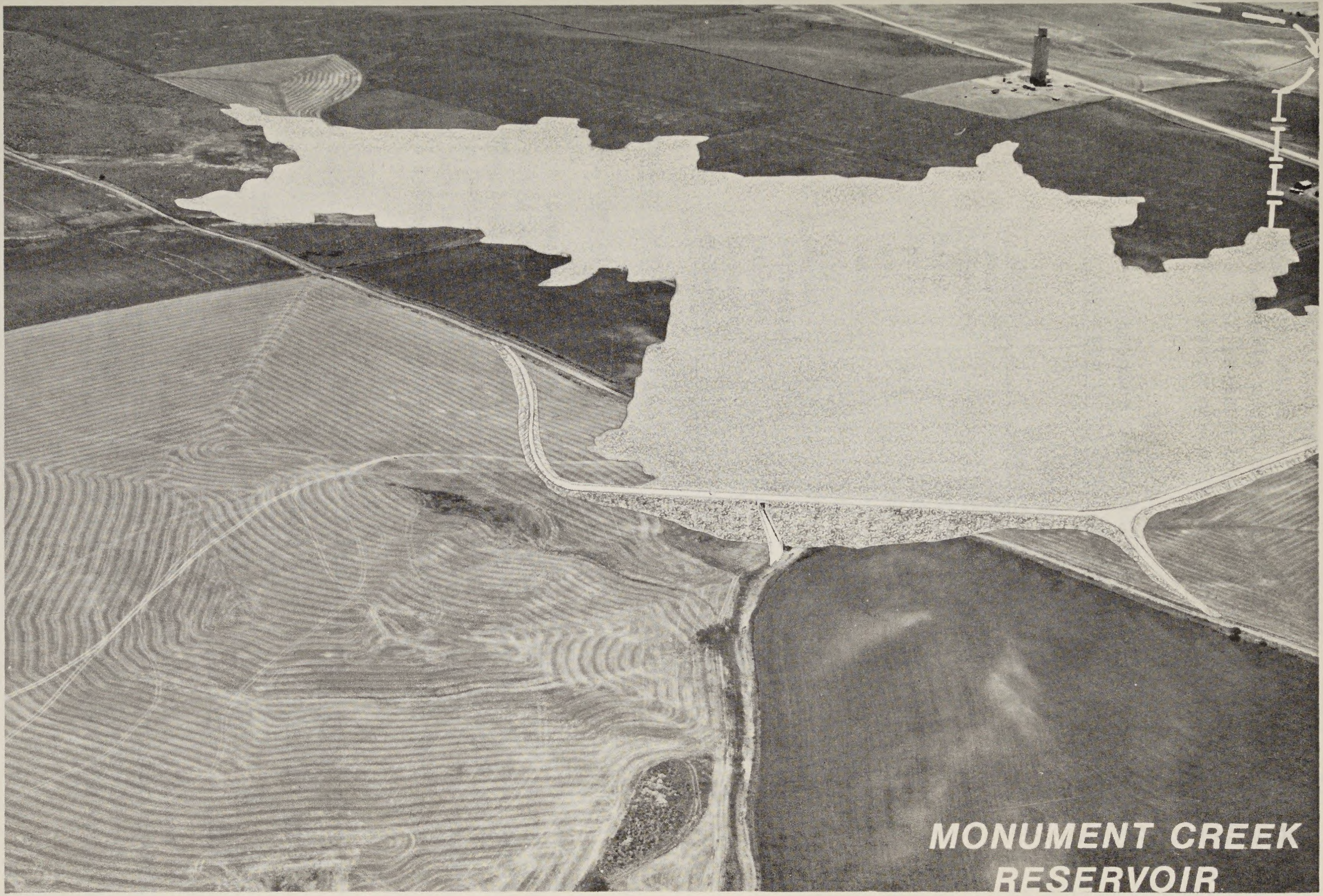


Figure A-9--Artist's conception of Monument Creek Dam and Reservoir. In the background, the Dove Creek Canal is shown leading to the reservoir.

season. The reservoir operation would be generally uniform from year to year. The largest drawdown would be 11 feet during the winter, when inflows from McPhee Reservoir would be halted, but municipal and industrial releases would still be made through the outlet works. Table A-7 shows the average end-of-month contents for the reservoir.

Table A-7
Monument Creek Reservoir
Average end-of-month content

Month	Content (acre-feet)	Surface area (acres)
January	390	56
February	290	46
March	190	33
April	130	25
May	390	56
June	290	46
July	190	33
August	390	56
September	690	84
October	690	84
November	590	76
December	490	62

c. Dawson Draw Reservoir

(1) Design Data

Dawson Draw Dam would be a rolled, earthfill structure. The outlet works and spillway would be located in the right abutment of the dam. The outlet works would have no day-to-day operational function but would be provided so that downstream flows could be maintained during the initial filling and so that the reservoir could be drained if necessary. Table A-8 provides technical data about the dam.

Table A-8
Dawson Draw Dam

Crest (feet)			Material volume (cubic yards)	Discharge capacity (second-feet)	
Height	Length	Width		Outlet works	Spillway
56	1,085	30	106,000	150	9,300

Dawson Draw Reservoir would extend about 1.5 miles up Dawson Draw. A surcharge capacity would be provided to store floodflows until they could be discharged over the spillway. Sediments would occupy a volume of 480 acre-feet after 100 years. Capacities would be as shown in Table A-9.

Table A-9

Dawson Draw Reservoir capacities

	Capacity (acre-feet)	Elevation (feet)	Surface area (acres)
Inactive capacity	3,210	6,543	294
Dead storage	100	6,520	20
Total	3,310		
Surcharge capacity	2,360	6,550	394

(2) Clearing and Relocations

The construction of Dawson Draw Reservoir would require no relocations, but a portion of a county road would be abandoned. U.S. Highway 666 and two county roads would provide access. The reservoir basin would not be cleared, since the vegetation would provide for better fish and wildlife habitat.

(3) Reservoir Operations

Dawson Draw Reservoir would be operated to provide habitat for fish, waterfowl, upland game, and other wildlife. It would initially be filled with water diverted from McPhee Reservoir through an existing MVIC canal, and subsequently its level would be maintained with irrigation return flows accumulating in the reservoir. The water surface would fluctuate only a few inches, even during dry years, and the inflow would spill to maintain flows below the dam.

d. Conveyance Systems

(1) Dolores Tunnel

The Dolores Tunnel would be a concrete-lined structure 1.3 miles long. It would have a working diameter of 9 feet and a maximum capacity of 520 second-feet. A gate house at the intake side of the tunnel would regulate releases to the Dolores Canal. A 4,000-foot-long section of the river channel within the reservoir basin would be excavated to form an inlet channel 16 feet deep and 20 feet wide at the bottom, allowing the delivery of water to the tunnel when the reservoir was low. The tunnel spoil material would be removed to the reservoir basin, where it would be deposited and shaped.

(2) Canals

The Cortez-Towaoc Pipeline would be a buried concrete structure varying in diameter from 15 to 10 inches. The four project canals would be for the most part earth-lined structures although some sections would be concrete-lined. A number of inline structures such as siphons, road crossings, bridges, wasteways, and check structures (gates to control canal flow) would also be constructed. Permanent operation and maintenance roads would be located along the canals and would vary in width from 12 to 14 feet. Additional technical information concerning the pipeline and canals is presented in Table A-10.

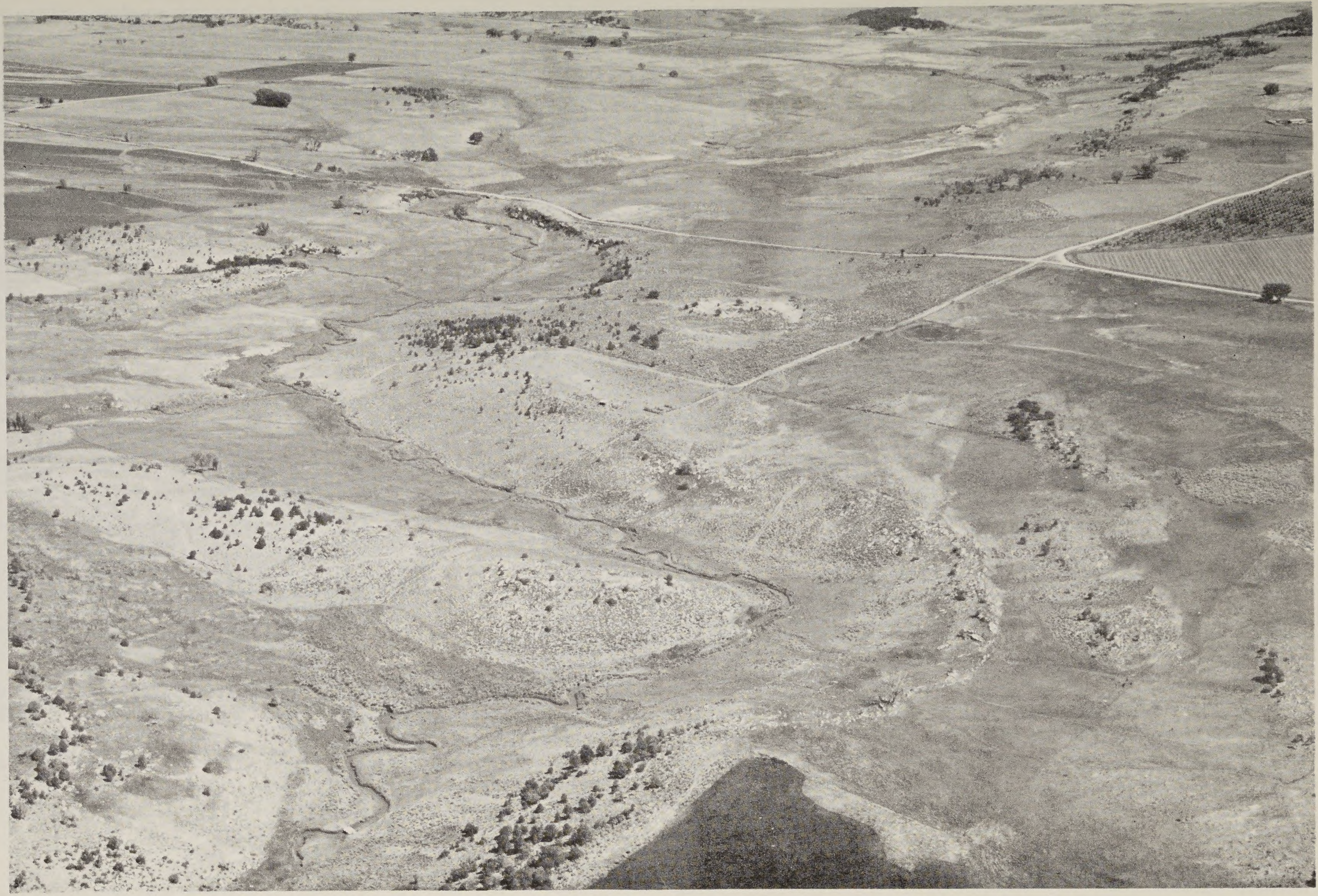


Figure A-10--Aerial viewing of Dawson Draw Dam and Reservoir site.

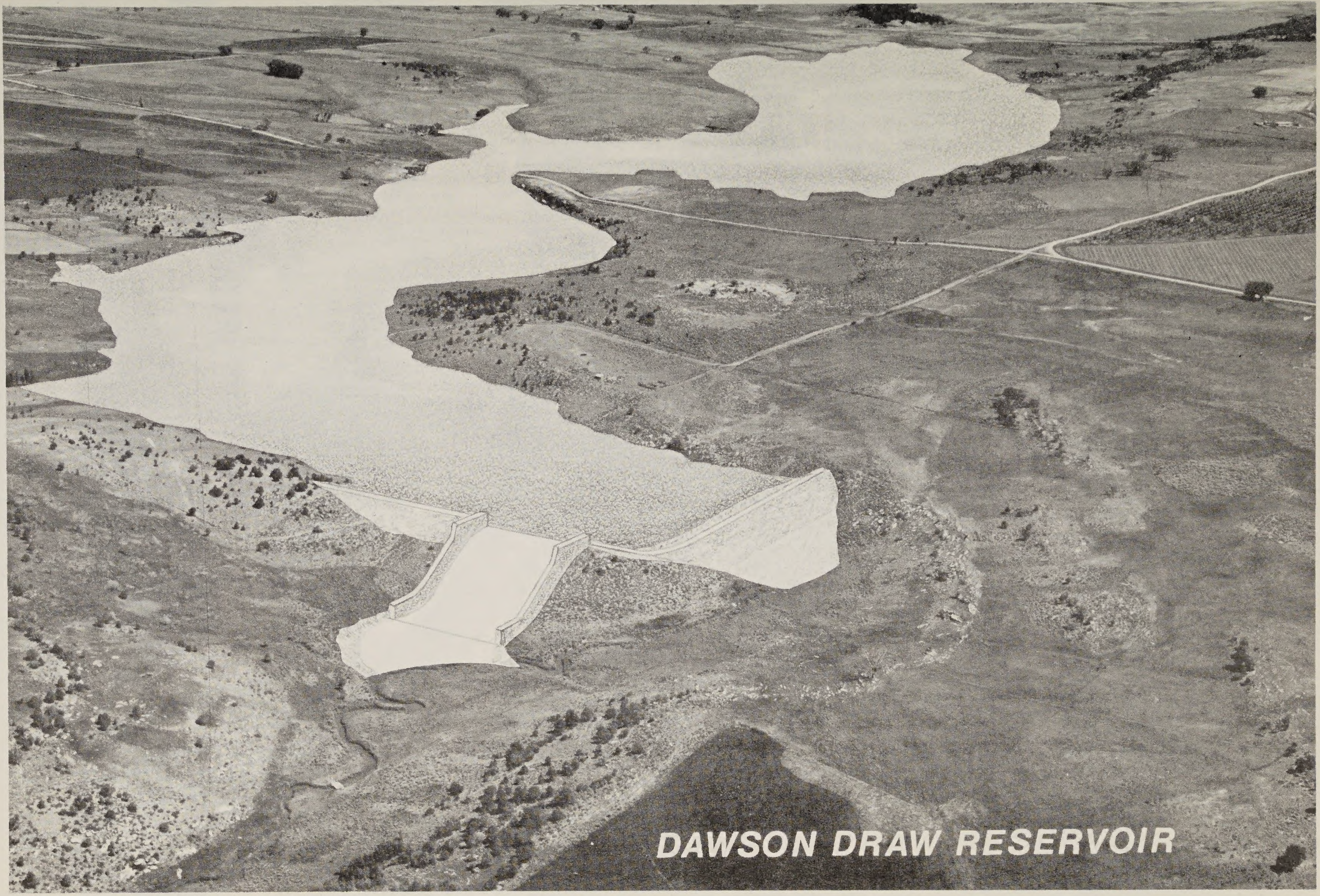


Figure A-11--Artist's conception of Dawson Draw Dam and Reservoir.

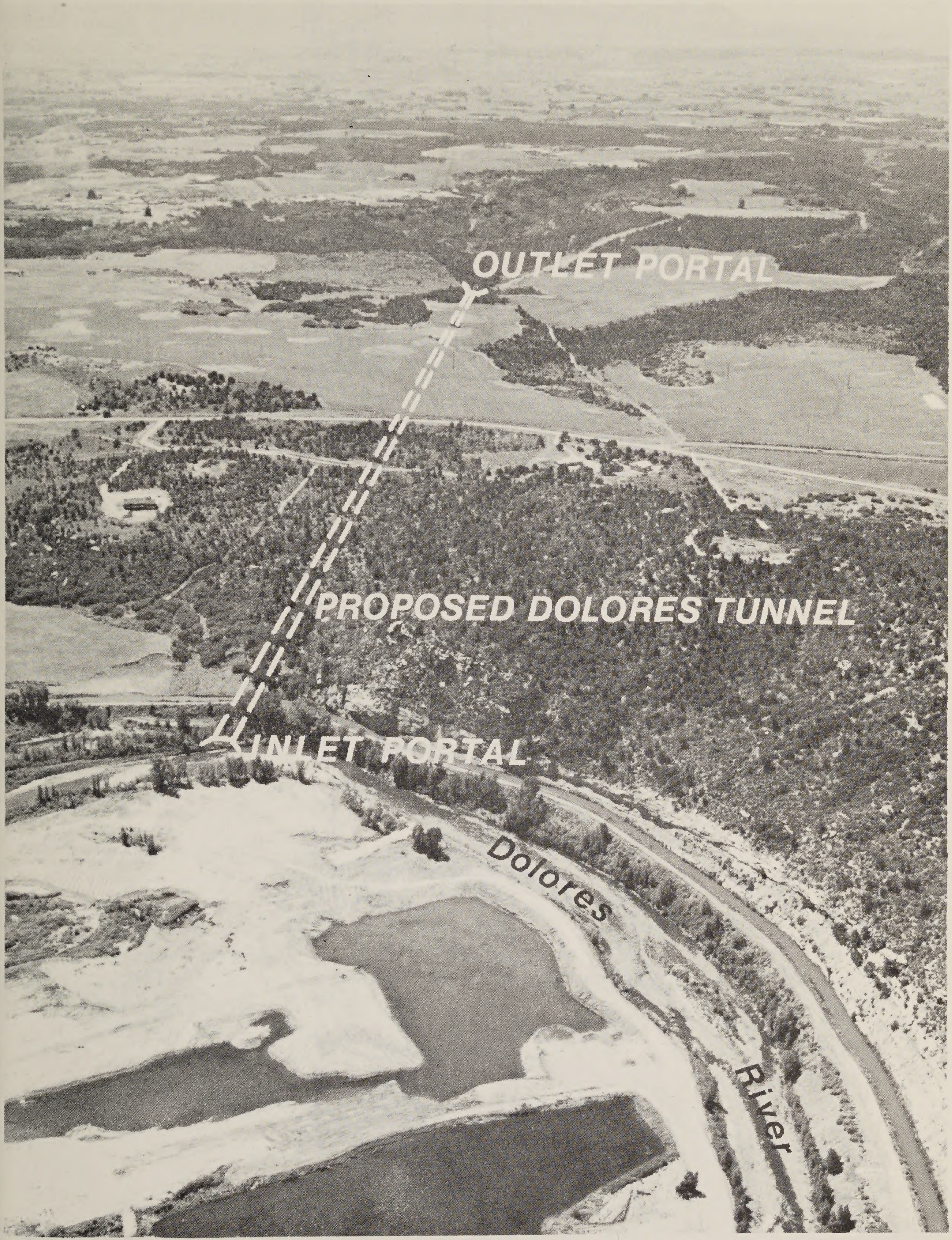


Figure A-12--View showing the proposed alignment of the Dolores Tunnel.

Table A-10
Dolores Project canals

Canals	Length (miles)				Initial dimensions			Terminal dimensions		
	Total length	Earth-lined sections	Concrete-lined sections	In-line structures	Water depth (feet)	Water width (feet)	Capacity (second-feet)	Water depth (feet)	Water width (feet)	Capacity (second-feet)
Dove Creek Canal	39.5	32.0	3.6	3.9	5.8	41	380	2.1	9.2	30
South Canal	7.6	6.0	1.2	.4	4.1	27	160	2.0	8.8	30
Dolores Canal	1.3	1.3		(Minor)	5.8	49	520	3.4	17	70
Towaoc Canal	45.4	31.8	7.5	6.1	3.4	24	135	3.3	20	86
Cortez-Towaoc Pipeline	19.5						17.3			2.9
Total	1/113.3	71.1	12.3	10.4						

1/ Including 19.5 miles of Cortez-Towaoc Pipeline.

Rights-of-way along the alignments would vary from 50 to 300 feet, depending on the capacities of the canals. Generally, the width would be approximately 100 feet in addition to the canal and operation and maintenance roads. Construction right-of-way for the Cortez-Towaoc Pipeline would vary in width from 30 to 50 feet. Access to all project lands associated with the canals is adequate; thus, no access roads would be built.

Fencing would be installed along the right-of-way boundaries of all project canals. Barbed wire stock fences with a maximum height of 3.5 feet would be installed along many of the open, earthlined sections of canal. Safety fences 5 to 7 feet high would be installed along chutes in the earth-lined sections, along all of the concrete-lined sections, and around all pipe and drop inlets. In addition an 8-foot deer fence would be placed along a concrete-lined section of the Towaoc Canal in McElmo Creek Canyon. Table A-11 gives a quantified breakdown of the fencing.

Table A-11
Canal fencing
(miles)

	Dove Creek Canal	South Canal	Dolores Canal	Towaoc Canal	Total
Livestock fence	12.1	6.4	0.5	10.3	29.3
Safety fence	.8	.8	.8	7.7	10.1
Deer fence				9.5	9.5

All project canals with the exception of the Dolores Canal would be operated from April to mid-October. The Dolores Canal would be operated year-round so that municipal and industrial water could be delivered to the Cortez-Towaoc Pipeline.

(3) Irrigation Lateral Systems

Approximately 85 miles of pressure pipe laterals would be constructed, consisting of about 65 miles of laterals in the Dove Creek area and about 20 miles of laterals in the Towaoc area. The laterals would be buried about 4 1/2 feet deep. The construction right-of-way along the laterals would be approximately 70 feet in width and would include a total of 718 acres. Although no permanent roads would be constructed along the laterals, permanent easements would be obtained for operation and maintenance. These easements would be 30 feet wide for all laterals, and would include 236 acres in the Dove Creek area and 73 acres in the Towaoc area. To drain the laterals after the irrigation season, air valves and drain valves would be installed at the high and low points of the systems.

A trashrack would be located at the head of each of the laterals to prevent trash from clogging the pipelines. For added protection, electrically operated water screens would be installed on lateral turnouts in Towaoc area. To furnish power from the Colorado River Storage

Project for the screens, a project transmission line would extend 16 1/2 miles from the town of Towaoc to the end of the canal. The line would receive power through an existing local utility. Made of wood, the transmission poles would be 30 to 60 feet high, depending on the terrain, with a single or double cross-arm about 8 feet long. Additional information concerning the lateral system is presented in Table A-12.

Table A-12
Dolores Project laterals

Laterals	Type of structure	Initial capacity (second-feet)	Length (miles)	Irrigated area to be served (acres)
From Dove Creek Canal				
Fairview	Buried pipeline	98	16.6	7,700
Cahone	Buried pipeline	72	12.5	5,680
Cross Canyon	Buried pipeline	20	5.0	1,410
Monument Creek	Buried pipeline	23	3.1	1,640
Subtotal			37.2	16,430
From South Canal				
Pleasant View	Buried pipeline	36	5.3	2,760
Ruin Canyon	Buried pipeline	85	14.7	6,670
Hovenweep	Buried pipeline	28	7.5	2,000
Subtotal			27.5	11,430
From Towaoc Canal				
First lateral	Buried pipeline	13	1.8	697
Second lateral	Buried pipeline	11	2.8	590
Third lateral	Buried pipeline	20	1.5	1,087
Fourth lateral	Buried pipeline	28	4.3	1,703
Fifth lateral	Buried pipeline	53	9.6	3,423
Subtotal			20.0	7.500
Total			84.7	35,360

(4) Pumping Plants

The Great Cut Pumping Plant, covering about 200 feet by 300 feet within a chain link fence, would consist of a concrete building to house the pumping units, a parking area, and a switchyard. Through separate discharge lines at the plant, eight pumping units would deliver water to the Dove Creek Canal and two pumping units would deliver water to the "U" Lateral. In the 46-year project operation study, pumping to the lateral was required in 15 years, usually from June through September.

The Great Cut Pumping Plant would be accessible from Colorado Highway 145 by the access road to McPhee Dam. Power for the Great Cut Pumping Plant would be obtained from the Colorado River Storage Project and a new 115-kV above-ground line 1 1/2 miles long would be required to connect the existing transmission lines to the pumping plant.

Six pumping plants for the laterals, four along the Dove Creek Canal and two along the South Canal, would pump water into standpipes or elevated steel tanks to provide sprinkler irrigation pressure.

The operation of these plants would be fully automated since float levels in the tanks would govern the pump operations. Each site, enclosed by a fence, would be approximately 200 feet by 160 feet and would contain an electrical switchyard to provide power for the plant.

The pumping plants would be located near existing county roads next to the canals, and the only new access roads needed would be at Pleasant View (1/2 mile) and at Ruin Canyon (1/4 mile). Power from the Colorado River Storage Project would be transmitted over the existing 44-kV lines of a local utility, and new above-ground lines of about 1/2 mile would be needed only for the Pleasant View Pumping Plant.

All project pumping plants would be operated from April through mid-October. Table A-13 gives additional data for each of the pumping plants.

Table A-13
Project pumping plants

Pumping plant	No. of units	Maximum flow (second-feet)	Peak electrical capacity (kW)	Average annual energy requirement (kWh)
Great Cut Pumping Plant				
Dove Creek	8	380	5,500	5,800,000
"U" Lateral	2	72	280	99,000
Dove Creek Canal				
Fairview	6	98	2,220	3,500,000
Cahone	6	72	1,550	2,500,000
Cross Canyon	4	20	220	310,000
Monument Creek	4	23	340	480,000
South Canal				
Pleasant View	5	36	700	1,100,000
Ruin Canyon	6	35	1,950	3,000,000

e. Drainage Facilities

Project drainage facilities would be provided for both the Dove Creek and Towaoc areas in locations to be determined on the basis of needs demonstrated during the first years of project operations. Estimates based on a survey of soil characteristics indicate that 24 miles of drains would be required in the Dove Creek area and 51 miles in the Towaoc area. The drains would consist of pipes buried at a depth of about 7 feet, manholes, and outlet channels. After construction was completed and vegetative cover restored, the portions of the drains above ground would consist of the manholes made of steel or concrete pipe and outlet channels to existing drainageways in the San Juan River Basin.

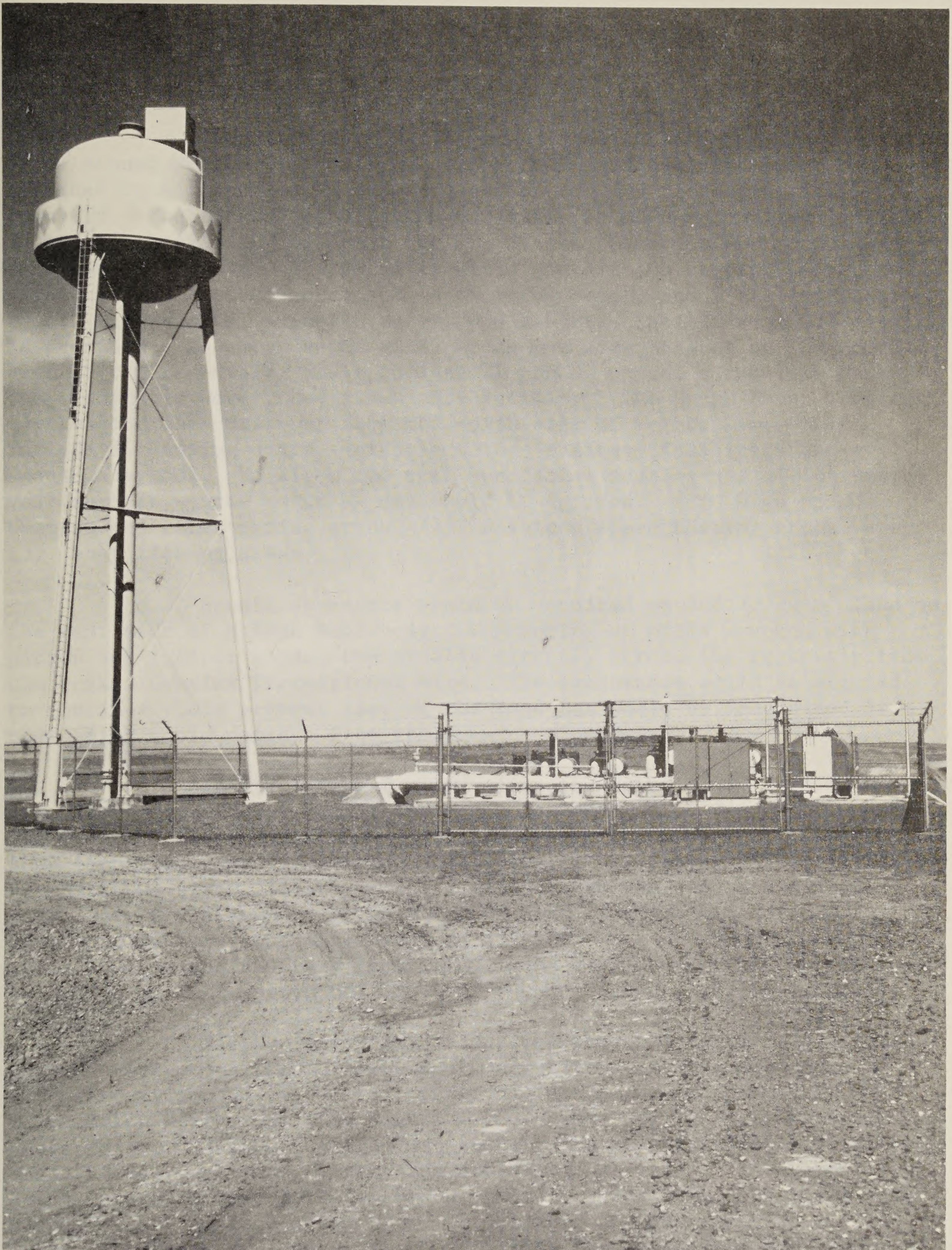


Figure A-13--Project pumping plants for the lateral systems in the Dove Creek area would be similar to the one shown in the above photograph.

f. Recreation and Fish and Wildlife Developments

(1) Recreation Developments

Recreational facilities would be constructed at three sites around McPhee Reservoir, as shown in Figure A-7, and would be designed to accommodate an expected use of 186,600 recreation days annually. The largest development would be the McPhee Complex, located on the south side of the Great Cut arm of the reservoir and accessible by a new paved road. The facility would contain 100 camping units, 40 picnic units, a scenic overlook, a swimming beach, and a six-lane boat ramp. Electricity, domestic water, and sanitary facilities would also be provided. The Dry Canyon site, a day-use area located on the north side of the reservoir, would include 20 picnic units, a two-lane boat ramp, domestic water, and a sanitary facility. The Hoppe Point Complex, overlooking the reservoir from the north side of McPhee Dam, would include 80 camping units, domestic water, sanitary facilities and a scenic overlook. To allow the most beneficial boating use of the reservoir surface, three zones of use would be defined: (1) high speed boating and water skiing areas, (2) wakeless speed boating areas, and (3) boat fishing areas.

Scenic easements would be acquired on 508 acres of land on the east side of McPhee Reservoir. Consisting of hills covered with pinyon and juniper woods, the area is directly across the reservoir from the McPhee Complex recreational site. The landowners would be allowed to continue their present uses of the land but would be prohibited from uses which would detract from the scenic value.

In the first 10 miles along the Dolores River below McPhee Dam, four recreational facilities would be constructed (see Figure A-14). The first, located immediately downstream from the dam, would include a boat launching ramp and camping area. The Ferris Canyon and Cabin Canyon recreational sites, located 5 and 9 miles below the dam, would have facilities for fishermen. The Williams Draw site, 12 miles below the dam, would accommodate boat launching and camping. All of the sites would include water and sanitary facilities. The facilities would be designed to handle an anticipated use of about 60,800 recreation days annually.

Farther downstream, four recreational facilities serving general recreation needs, fishermen, and white-water boaters would be dispersed at one-day float trip intervals extending approximately 105 miles below McPhee Dam (See Figure A-15). The facilities at Mountain Sheep Point, Slickrock, Little Gyp Valley, and Bedrock would have picnic areas, launching ramps, water, and sanitary facilities. Mountain Sheep Point, approximately 25 miles below the dam, would also contain 22 camp sites. The four facilities would be designed for the expected use of 9,820 recreation days annually. Access to the downstream facilities would be over existing roads.

In conjunction with the project operations for flood control, white-water boating flows would be provided by forecasting the high

Figure A-14
Dolores River Recreation Facilities
Dolores Project, Colo.

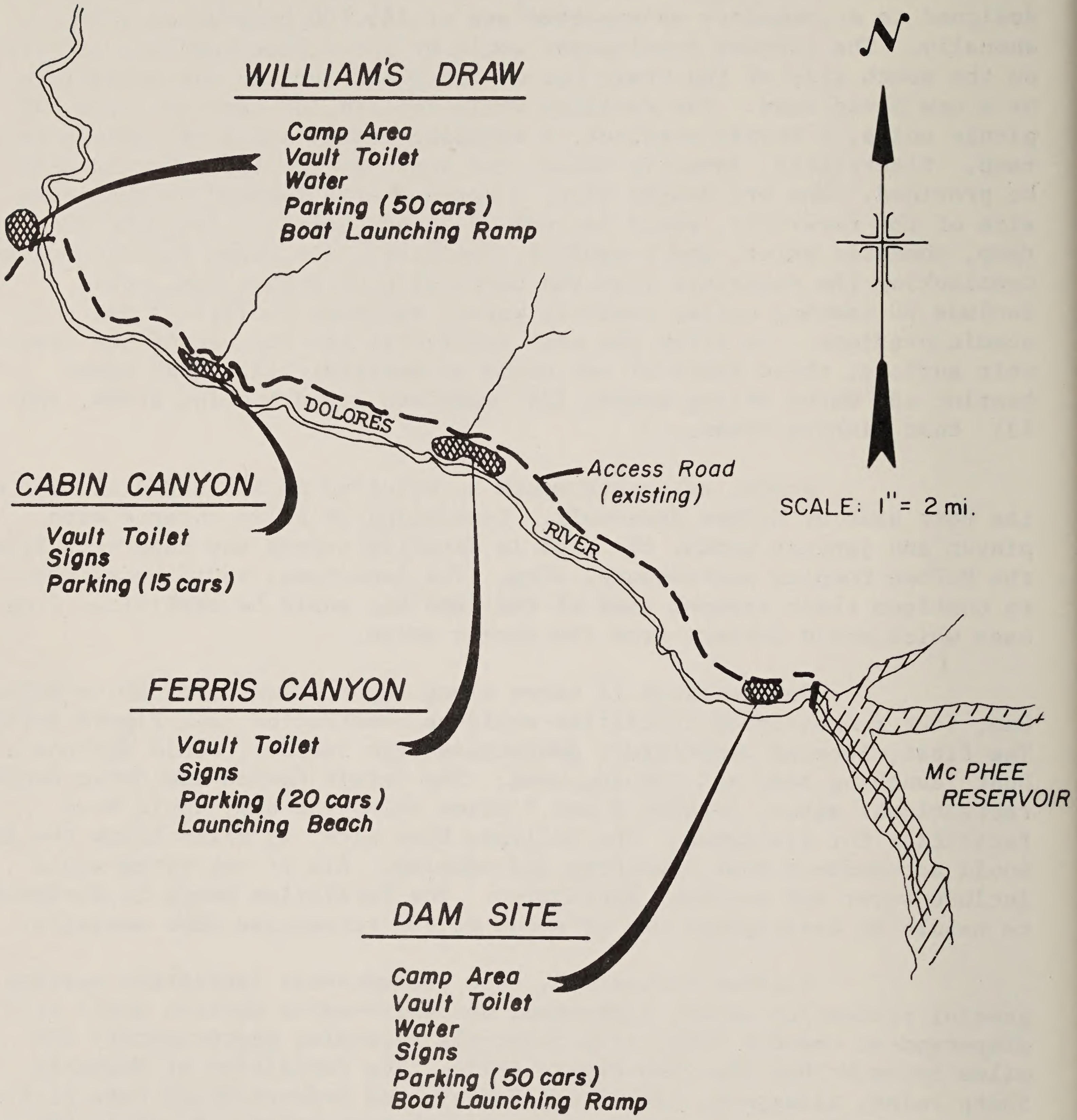
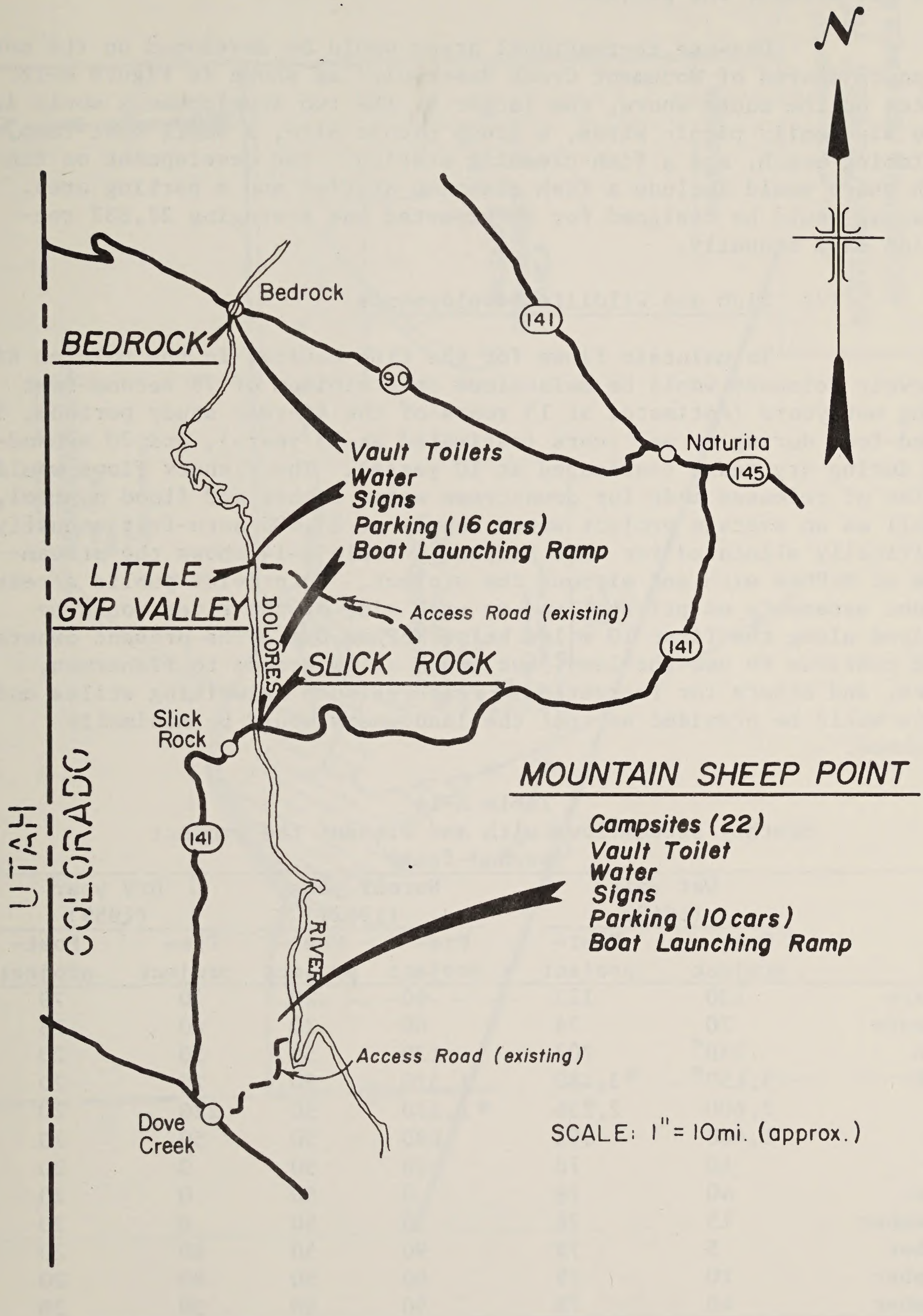


Figure A-15

Dolores River Recreation Access Facilities

Dolores Project, Colo.



runoff which normally occurs during May, June, and July and making releases from McPhee Reservoir in anticipation of spills. The estimated boating days would average 2,580 annually, an increase of 1,320 days over anticipated use without the project.

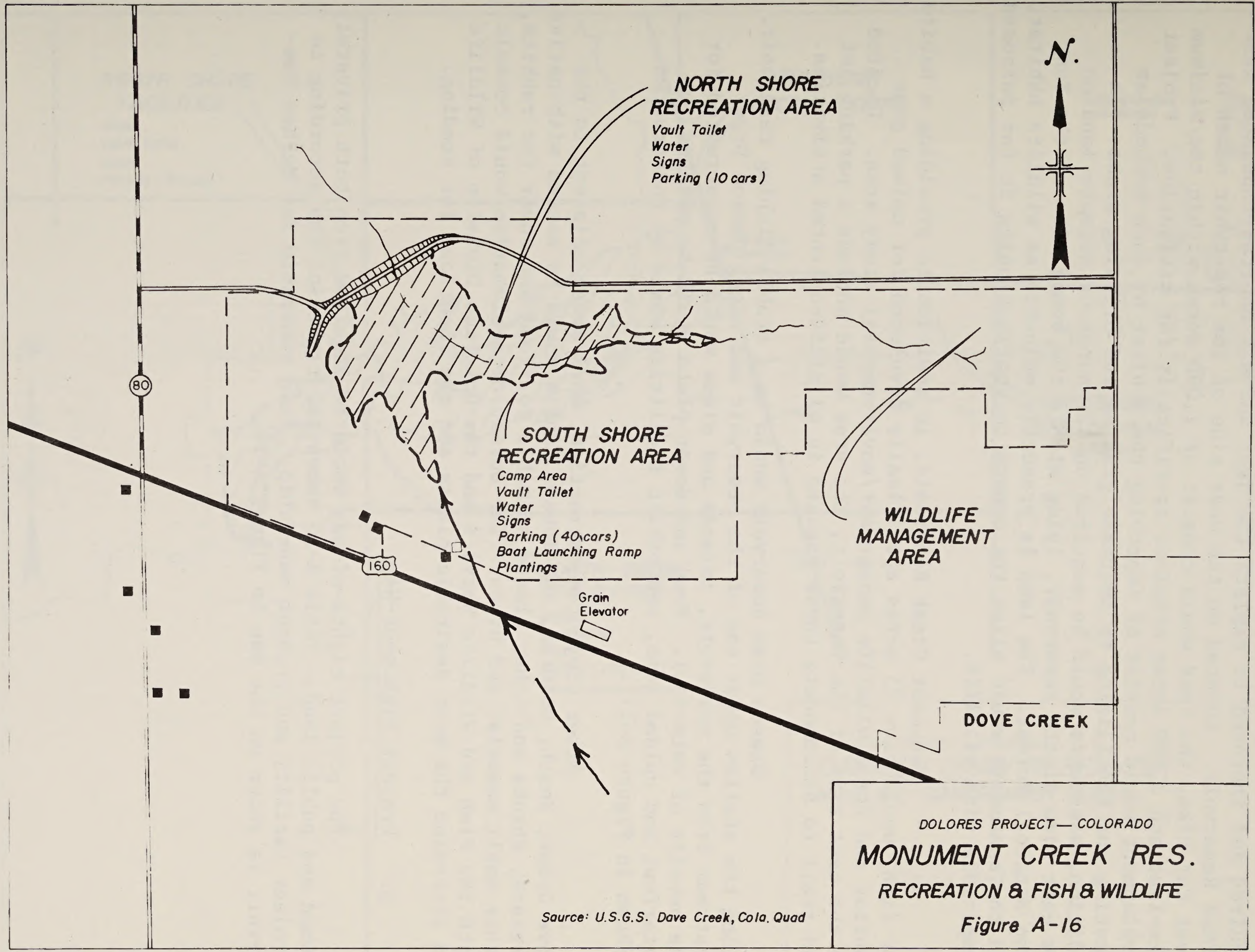
Day-use recreational areas would be developed on the north and south shores of Monument Creek Reservoir, as shown in Figure A-16. Located on the south shore, the larger of the two developments would include six family picnic sites, a group picnic site, a small boat ramp, a swimming beach, and a fish cleaning station. The development on the north shore would include a fish cleaning station and a parking area. The areas would be designed for an expected use averaging 22,882 recreation days annually.

(2) Fish and Wildlife Developments

To maintain flows for the fish habitat in the Dolores River, reservoir releases would be maintained at a minimum of 78 second-feet during wet years (estimated at 13 years of the 46-year study period), 50 second-feet during normal years (estimated at 23 years), and 20 second-feet during dry years (estimated at 10 years). The fishery flows would consist of releases made for downstream water rights and flood control, as well as an average project water supply of 25,400 acre-feet annually specifically allocated for that purpose. Table A-14 shows the streamflows at McPhee with and without the project. To provide public access, 25-foot easements on private land on each side of the river would be acquired along the first 10 miles below McPhee Dam. The present owners would continue to use the land, but would allow access to fishermen, hikers, and others for recreation. Features such as walking stiles and trails would be provided so that the landowners would be minimally disturbed.

Table A-14
Monthly streamflows with and without the project
(second-feet)

	Wet year (1942)		Normal year (1962)		Dry year (1959)	
	Pre-project	Post-project	Pre-project	Post-project	Pre-project	Post-project
January	130	123	60	20	30	78
February	70	74	80	20	40	78
March	230	207	130	50	50	20
April	3,150	3,180	1,370	50	20	20
May	2,600	2,236	1,170	50	220	20
June	1,680	992	690	50	50	20
July	40	78	10	50	0	20
August	40	78	0	50	0	20
September	15	78	0	50	0	20
October	5	78	90	50	60	20
November	10	78	60	50	80	20
December	40	78	50	50	30	20



DOLORES PROJECT — COLORADO

MONUMENT CREEK RES.

RECREATION & FISH & WILDLIFE

Figure A-16

Source: U.S.G.S. Dave Creek, Colo. Quad

As part of the project, 4,150 acres of land would be acquired and improved to replace the deer and elk habitat inundated at McPhee Reservoir. Located on the west side of the reservoir north of Great Cut Dike, the land would consist of 1,090 acres within the minimum take-line and 3,060 acres obtained specifically for mitigation. Project development would consist of improving the habitat by such methods as planting and fertilizing to increase grazing and browsing areas. In addition, easements would be acquired on 420 acres of private land on the east side of the reservoir, lying within the boundaries of the San Juan National Forest. The land is presently valuable as wildlife habitat, and the easements would allow the owners to continue using it for purposes compatible with wildlife.

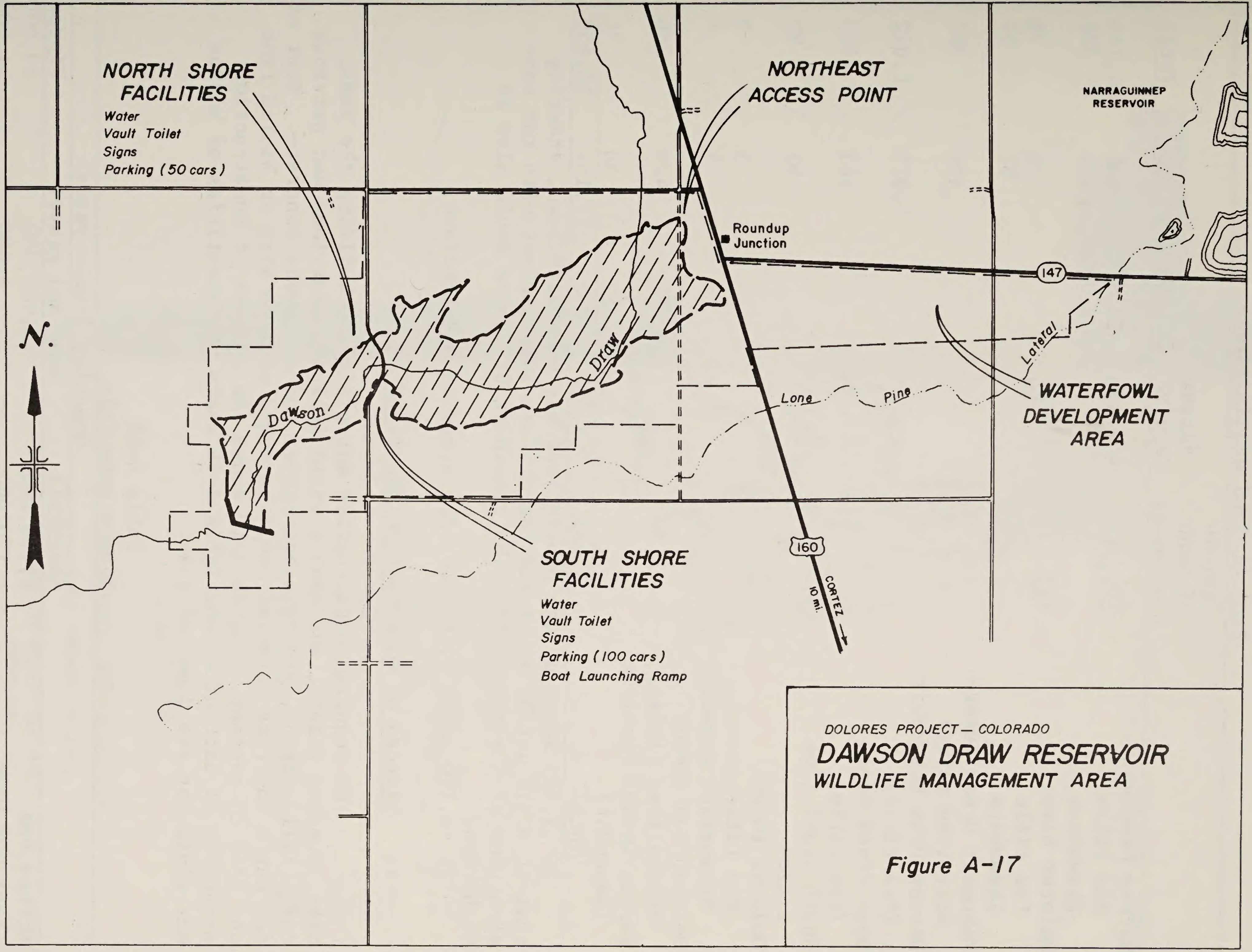
Monument Creek Reservoir, in addition to providing a habitat for fish, would have 75 acres specifically developed for upland game habitat and for a wildlife management/environmental study area. Located on the east side of the reservoir, the area would include a parking lot and trail to accommodate those engaged in wildlife-oriented activities.

Dawson Draw Reservoir would be a stable fishing reservoir. Along the shallow upper end of the reservoir and along Dawson Draw upstream from the reservoir, islands and dikes would be constructed for the benefit of waterfowl. Food and cover plots would be planted for waterfowl and upland game, and public facilities would be constructed (shown in Figure A-17).

After project construction, work areas adjacent to the Dove Creek, South, Dolores, and Towaoc Canals would be seeded with native grasses, shrubs and other plants suitable for food and cover for rabbits, other small mammals, and birds. The Bureau of Reclamation would consult with the Fish and Wildlife Service and the Colorado Division of Wildlife to determine the most desirable plants and the locations for seeding.

g. Project Rights-of-Way

The project rights-of-way would be acquired from both privately owned and public land. Table A-15 shows the rights-of-way according to project facility and present ownership. Land ownership for McPhee Reservoir is shown on the map in Figure A-18.



DOLORES PROJECT — COLORADO

DAWSON DRAW RESERVOIR
WILDLIFE MANAGEMENT AREA

Figure A-17

Table A-15
Project land acquisition

	Bureau of Land Management	Forest Service	Indian	Private	Total
McPhee Reservoir					
Fee title	[1]2,282	[2]3,830		8,634	14,746
Easements				928	928
Dolores River					
Fee title		60		18	78
Easements				57	57
Monument Creek Reservoir (fee title)				372	372
Dawson Draw Reservoir (fee title)				1,072	1,072
Dove Creek Canal (fee title)				483	483
South Canal (fee title)				95	95
Dolores Tunnel					
Fee title				3	3
Subsurface easement				4	4
Dolores and Towaoc canals (fee title)	50		272	428	750
Cortez-Towaoc Pipeline (easement)			13	58	71
Total	2,332	3,890	285	12,152	18,659

[1] 1,365 acres of the public land has been withdrawn, ensuring that it would not be developed for any use inconsistent with the construction of the reservoir. The remaining 917 acres would also be withdrawn.

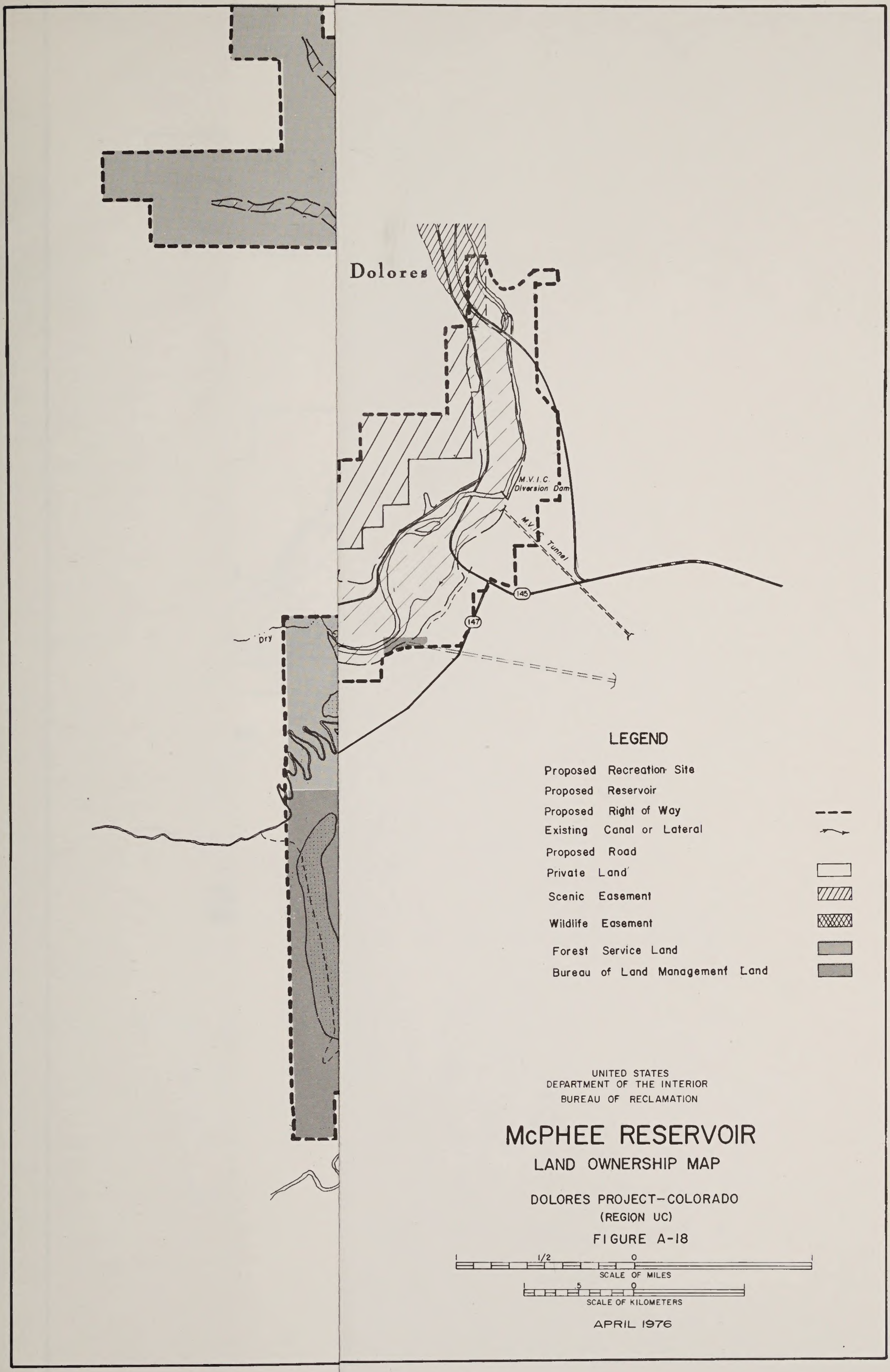
[2] 3,520 acres withdrawn; 310 acres to be withdrawn.

h. Sources of Construction Materials

The required construction materials for building the dams, dike, pumping plants, and canals would include impervious and pervious earth fill, riprap, concrete aggregate, and ready-mix concrete. Most of the earth and rock material could be found at each site or hauled from one site to another. Figure A-19 shows the sources of construction materials at each site, and Table A-16 lists the quantities of borrow materials for the dams and dike.

Table A-16
Borrow materials

	Quantity (cubic yards)		
	Earthfill	Sand and gravel	Riprap
McPhee Dam	2,100,000	2,900,000	29,000
Great Cut Dike	170,000	8,000	11,000
Monument Creek Dam	135,000	8,500	8,500
Dawson Draw Dam	92,000	7,500	6,500



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

McPHEE RESERVOIR
LAND OWNERSHIP MAP

DOLORES PROJECT—COLORADO
(REGION UC)
FIGURE A-18

APRIL 1976

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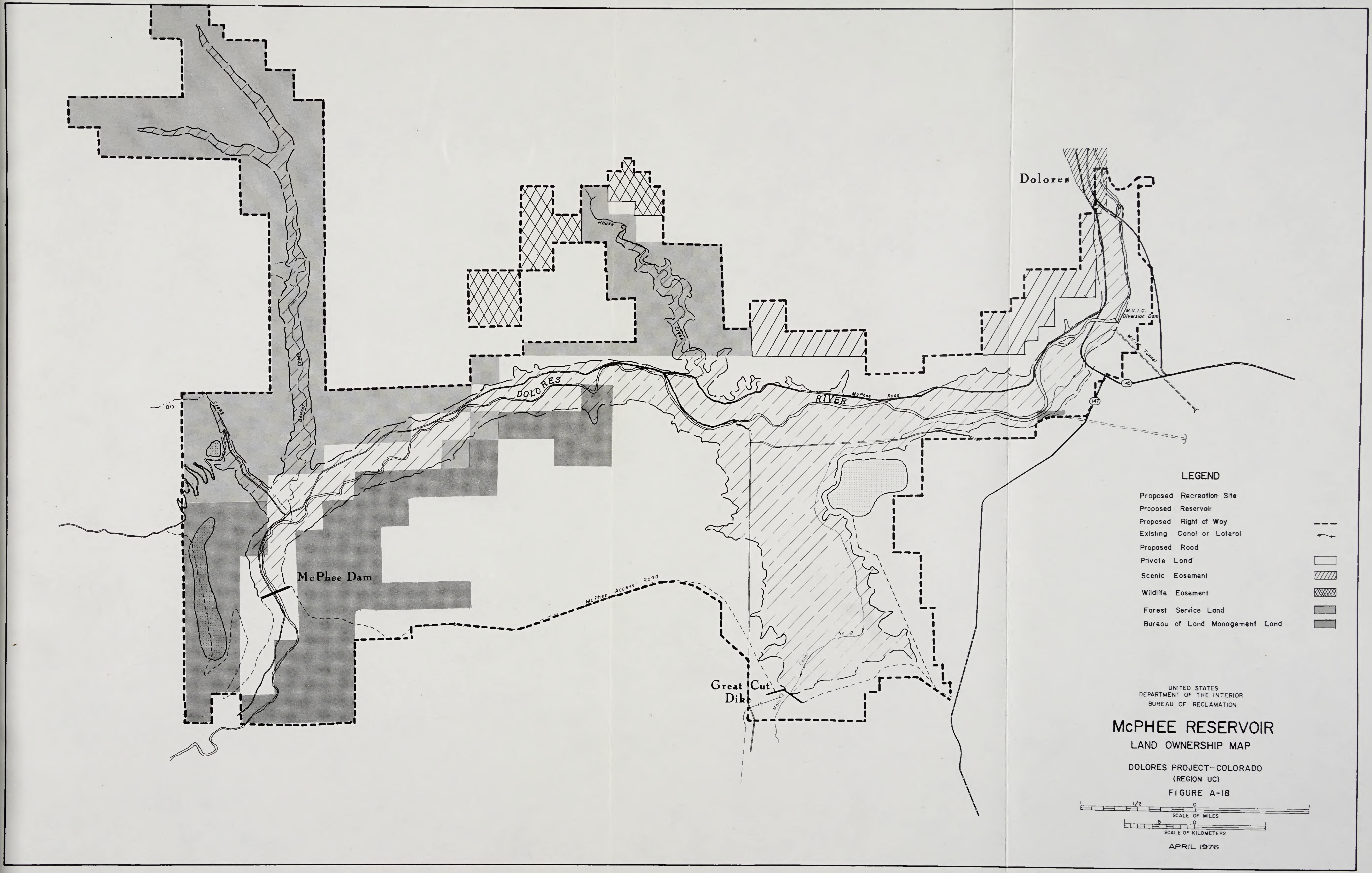
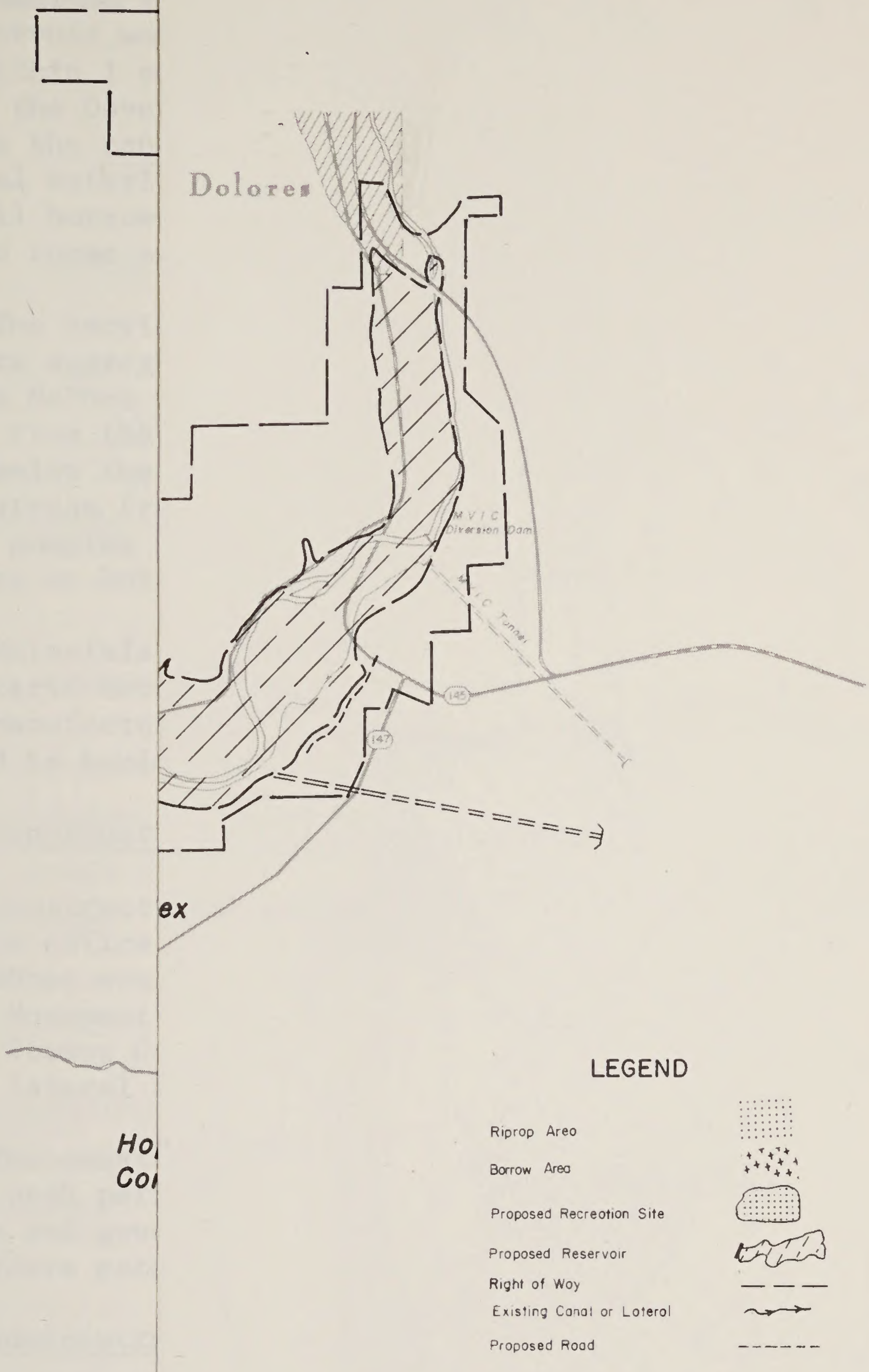


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

McPHEE RESERVOIR
LAND OWNERSHIP MAP
DOLORES PROJECT—COLORADO
(REGION UC)
FIGURE A-18

APRIL 1976



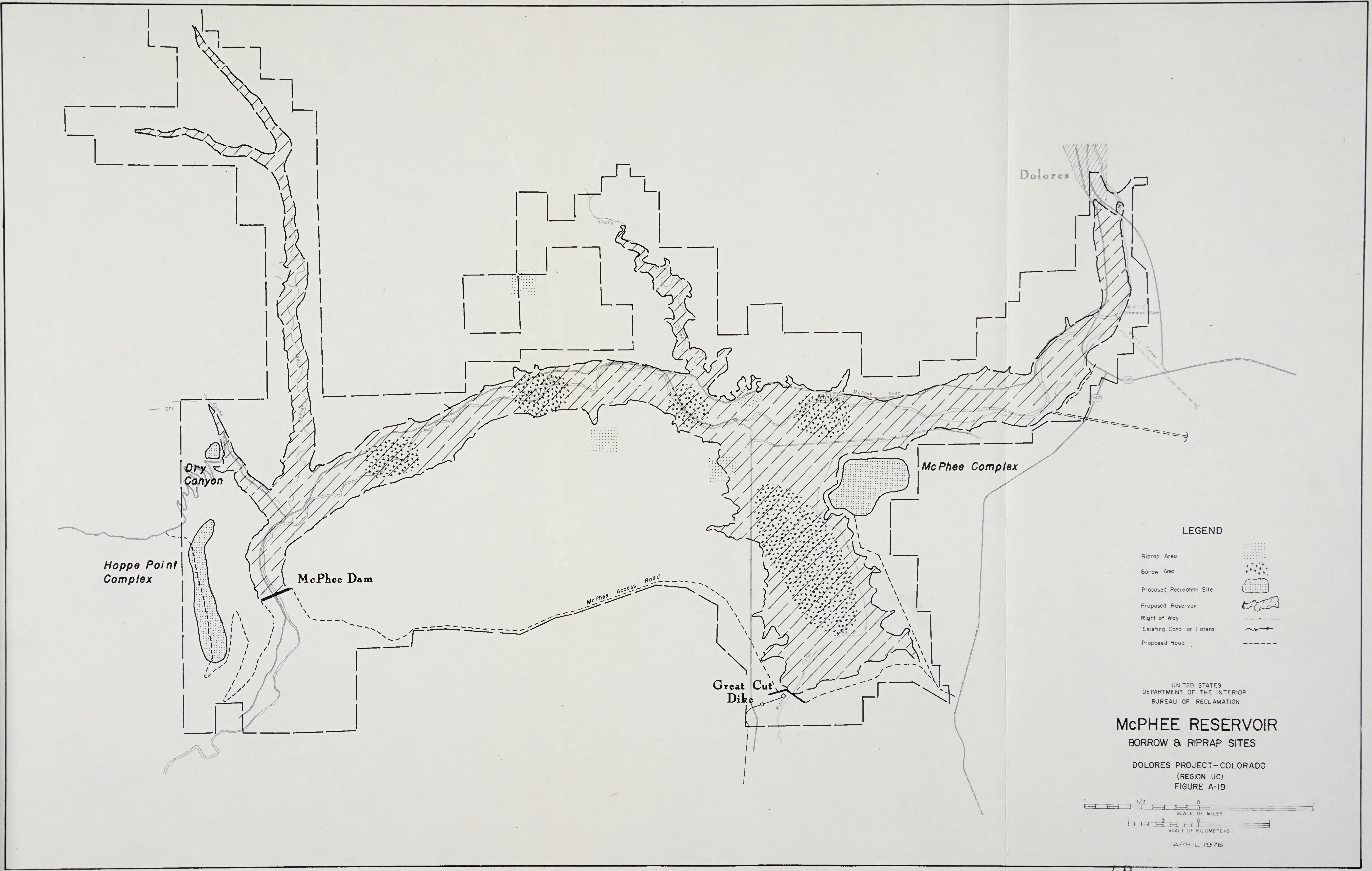
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

McPHEE RESERVOIR

BORROW & RIPRAP SITES

DOLORES PROJECT—COLORADO
(REGION UC)
FIGURE A-19

APRIL 1976



UNITED STATES
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McPHEE RESERVOIR
BORROW & RIPRAP SITES

DOLORES PROJECT—COLORADO
(REGION UC)
FIGURE A-19

APRIL 1976

The impervious material for McPhee, Monument Creek, and Dawson Draw Dams, Great Cut Dike, and the Dolores landfill would be available below the maximum water level of each reservoir. The borrow area within McPhee Reservoir would be located approximately 5 miles from the dam site and within 1 mile of Great Cut Dike. The impervious material required for the Dove Creek, South, Dolores, and Towaoc Canals would be found along the canal alignments. The Towaoc Canal, however, might need supplemental materials hauled in from other sections of the canal right-of-way. All borrow areas would be shaped to conform to the surrounding terrain and those outside the reservoir basin would also be seeded.

The pervious material used to construct the dams and dikes and the concrete aggregate used in building all project facilities would come from within McPhee Reservoir basin. The riprap sources for all facilities could come from the Dakota Sandstone found along the Dolores River Canyon above and below the maximum water level of McPhee Reservoir, approximately 5 miles upstream from the dam site. The ready-mix concrete used to construct the pumping plants and other project facilities would come from local plants at Dolores and Cortez.

Materials such as cement, pipe, steel gages and structures, pumps, electric motors, and operating and control equipment would most likely be manufactured or processed outside the project area. The materials would be hauled to the construction sites by truck or rail.

i. Construction Headquarters and Program

Construction of the Dolores Project would be supervised from a construction office located at Cortez. Temporary field offices and construction shops would be required at McPhee Dam; Great Cut Dike and Pumping Plant; Monument Creek Dam; Dawson Draw Dam; along the Dove Creek, South, and Towaoc Canals; and at each of the principal sprinkler pumping plants and lateral areas.

The construction of the project would take 9 years (see Figure A-20). At peak periods, the project would provide jobs for approximately 700 private and government employees, with a total of approximately 4,300 man-years extending over the 9-year period.

j. Administration, Operation, and Maintenance

The Dolores Water Conservancy District would be the general administrator of the project facilities associated with the Dove Creek Canal, South Canal, and Monument Creek Reservoir. It would also be the general administrator of the joint facilities of the project, McPhee Dam and Reservoir, Great Cut Dike and Pumping Plant, the Dolores Tunnel and Canal, and the Cortez-Towaoc pipeline as far as Cortez. The Ute Mountain Ute Indian Tribe would administer the Towaoc Canal, the irrigation facilities on the reservation, and the pipeline from Cortez to its facilities at Towaoc.

Figure A-20
Proposed construction schedule

Project Feature	Calendar Years								
	1	2	3	4	5	6	7	8	9
1. McPhee Dam, Dike & Reservoir	■	■	■	■	■	■			
Right-of-way	■	■	■						
Recreation Facilities			■	■	■	■			
Wildlife Habitat Improvements			■	■					
Archaeological Program		■	■						
2. Dolores Tunnel		■	■	■	■				
3. Great Cut Pumping Plant		■	■	■	■				
4. Dolores-Towaoc Canal			■	■	■	■	■	■	
5. Dolores Protective Dike				■	■				
6. Cortez-Towaoc M&I Pipeline				■	■				
7. Fairview Pumping Plant & Laterals				■	■	■			
8. Dove Creek Canal				■	■	■	■	■	
9. Monument Creek Dam & Reservoir					■	■	■		
Right-of-way					■	■			
Recreation						■	■		
Wildlife							■		
10. Dolores River Access Facilities					■	■	■		
11. Permanent Operating Facilities & O&M Housing					■	■	■	■	■
12. Cahone Pumping Plant & Laterals						■	■		
13. South Canal						■	■	■	
14. Cross Canyon Pumping Plant & Laterals							■	■	
15. Monument Creek Pumping Plant & Laterals							■	■	
16. Pleasant View Pumping Plant & Laterals							■	■	
17. Ruin Canyon Pumping Plant & Laterals								■	■
18. Hovenweep Laterals								■	■
19. Towaoc Laterals								■	■
20. Dawson Draw Dam and Reservoir							■	■	■
Right-of-way							■	■	
Wildlife								■	■

The headquarters of the Dolores Water Conservancy District would be located at the Great Cut Pumping Plant. Three houses would be built near the District's headquarters for operating personnel. If the Ute Mountain Ute Indian Tribe desired to administer its facilities, the Tribe would require an operation and maintenance headquarters that would probably be located at Towaoc.

The Forest Service would administer the recreation and fish and wildlife developments at McPhee Reservoir and would enter into a cooperative agreement with the Colorado Divison of Wildlife for the management of the wildlife area on the west side of the reservoir. The Forest Service and the Bureau of Land Management would administer the recreation facilities along the Colores River downstream from McPhee Dam. The town of Dove Creek would operate and maintain the recreation facilities at Monument Creek Reservoir in conjunction with the Dolores Water Conservancy District, and the Colorado Division of Wildlife would manage the Monument Creek Reservoir wildlife area. The Colorado Division of Wildlife would also administer the fish and wildlife development and facilities at Dawson Draw Reservoir. This agency would stock fish in the three project reservoirs and in the Dolores River downstream from McPhee Dam.

k. Archaeological Program[1/]

The archaeological program would be based on the recommendations made by archaeologists from the University of Colorado who have surveyed the project area. Their survey disclosed a total of 459 archaeological sites in the project area. They have recommended that 178 of the sites need no further evaluation since they are either or minor significance or their occupation period or function is better represented by other sites in the survey. They have recommended 144 sites along the canals and laterals be avoided by rerouting the alignment of the associated fatures wherever possible. In addition they have recommended that 137 sites be fully listed or fully excavated and that two petroglyphs be stabilized. The tests, either by core drilling or partial excavation, woudld be conducted at sites that do not appear to warrant comprehensive study. Should the tests indicate that any of the sites are more significant than surface studies have shown, complete excavation could be performed. The two petroglyphs, located in the vicinity of the proposed South Canal, would be stabilized to prevent further deterioration or possible destruction. The exact salvage program to be undertaken would be determined by the Bureau of Reclamation in coordination with the State Historic Preservation Officer and the Advisory Council on Historic Preservation.

Table A-17 gives the general location and recommended disposition of the sites surveyed.

[1/] Archaeological investigations of the project area are cited in the bibliography at the end of this statement.

Table A-17
Proposed archaeological program
(number of sites)

Feature	Surveillance No further work	 Flag and avoid and/or reroute	Test and/or excavate	Subtotal
McPhee Reservoir	58		69	127
Dolores River Canyon[1/]	22		18	40
Great Cut Dike, Dove Creek, and South Canals	58	13	16	87
Dove Creek Laterals	31	80	17	128
Towaoc Canal and Laterals	9	51	17	77
Total	178	144	137	459

[1/] To about 10 miles below the proposed McPhee Dam site.

CHAPTER B

DESCRIPTION OF THE ENVIRONMENT

B. DESCRIPTION OF THE ENVIRONMENT

1. Climate[1]

The climate of the project area is essentially semiarid and is characterized by low precipitation and humidity, abundant sunshine, a fairly large daily temperature range and small day-to-day changes, and moderate westerly winds. As a result of topographic changes, the local climate exhibits large variations within short distances, with increases in precipitation and decreases in temperature from southwest to northeast.

Average annual precipitation varies from less than 10 inches in the southwestern corner of the area to about 20 inches in the northeast. Precipitation varies considerably from year to year, but on the average June is the driest part of the year and July through October is the wettest. The remaining months are fairly uniform. Afternoon showers commonly occur during July through mid-September, occasionally reaching thunderstorm intensity. Damaging storms and other severe weather conditions are infrequent.

The typically clear skies and high solar radiation, combined with the elevation of the area, result in warm days and cool nights during the spring, summer, and fall. The days are also comfortably warm during the winter, but the nights are quite cold. Maximum daytime temperatures vary from about 32-40° F. in January to 80-90° F. in July, with corresponding nighttime minimums ranging from nearly 0° F. to around 50° F. Extreme high temperatures of over 100° F. have been recorded twice in Cortez, and extreme low temperatures have dropped below -25° F. The frost-free period varies from about 100 to 120 days in the Dove Creek area and about 130 to 140 days in the Montezuma Valley and Towaoc areas.

2. Air Quality

According to the Colorado Department of Health, Montezuma and Dolores Counties meet the Federal particulate standards for air quality.[2] The Federal primary standards for suspended particulates are averages of 260 micrograms per cubic meter (ug/m^3) over a 24-hour period or 75 ug/m^3 over a 1-year period. The secondary standard is a 24-hour average of 150 ug/m^3 (geometric). As Table B-1 shows, the annual mean concentrations of the two counties meet the standard.

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[1] Joseph W. Berry, "The Climate of Colorado," Climates of the States: Volume II--Western States, Including Alaska and Hawaii, ed. National Oceanic and Atomspheric Administration, U.S. Department of Commerce (Port Washington, N.Y.: Water Information Center, Inc., 1974), pp. 595-612.

[2] Colorado Department of Health, Air Pollution Control Commission, Annual Progress Report, 1975.

Table B-1
Suspended particulates, 1974
Montezuma and Dolores Counties
(µg/m^3)

Monitor Location	Quarterly geometric means 1st	2nd	3rd	4th	Annual geometric Mean	High	Low
Cortez	39*	**	46	***	44	133	18
Mesa Verde	8	19	16	8	12	82	2

* = average based on limited data
** = insufficient data
*** = no samples

Both counties are rural, with few industries to affect air quality, and wood waste-disposal burners and open-burning disposal areas are presently the major sources of suspended particulates. Although coal-fired power generation facilities are located in New Mexico about 40 miles south of Cortez, meteorological and monitoring studies have shown practically no pollutants from this region entering southwestern Colorado. The Department of Health predicts that air quality for the counties will continue to meet Federal particulate standards. Factors influencing this trend include favorable climate, low population density, enforcement of Colorado regulations, and continued intergovernmental coordination with neighboring states.

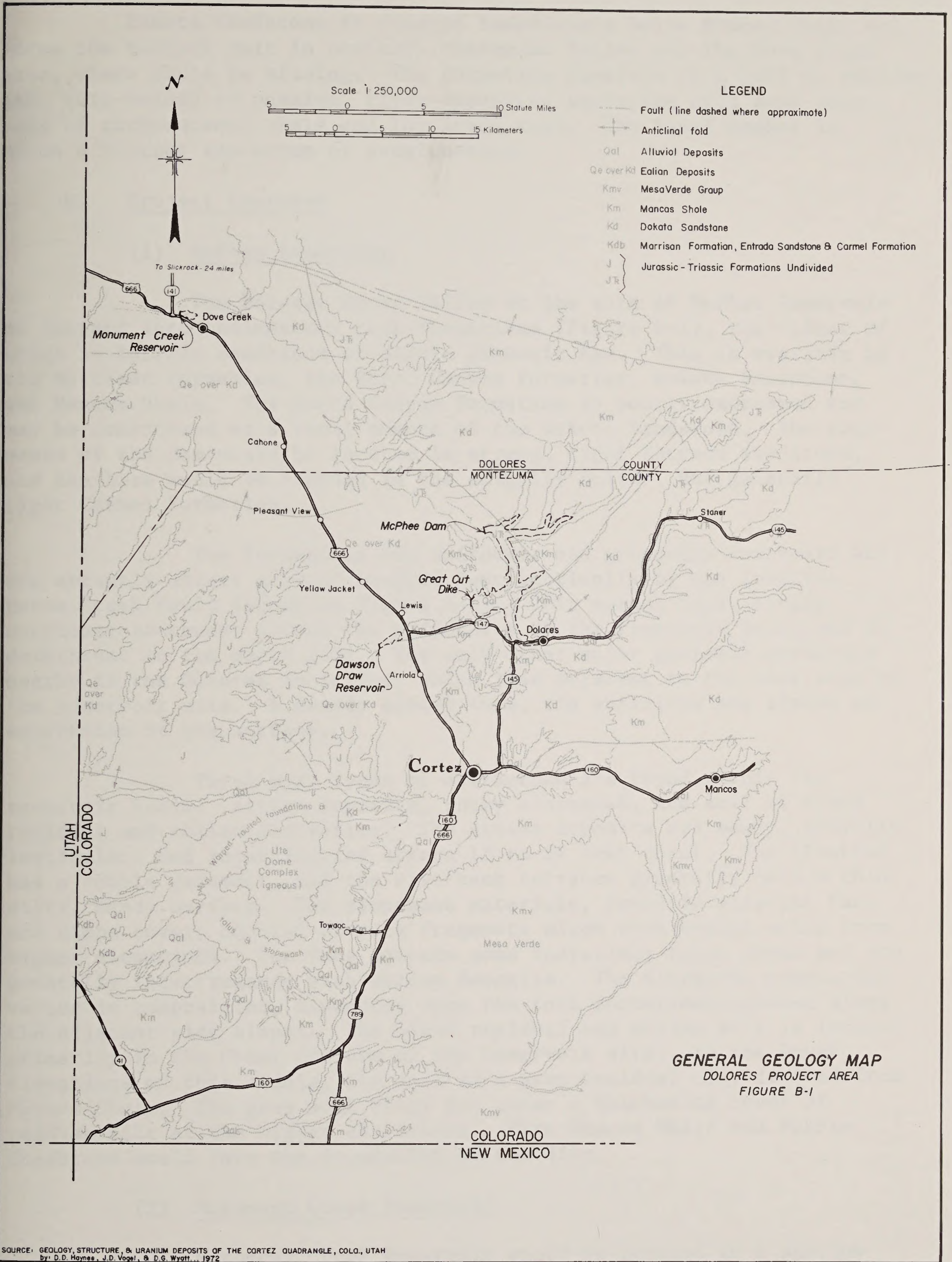
3. Geology

a. General

The project area, lying within the eastern portion of the Colorado Plateau physiographic province, has flat-lying or gently warped sedimentary formations that have eroded to form long shale slopes, prominent sandstone cliffs, and steep-walled canyons.[1/] Prominent physiographic features are Mesa Verde, which rises to an elevation of about 8,400 feet on the east side of Montezuma Valley; Ute Mountain, which rises to an elevation of about 10,000 feet to the west of the valley; and the Dolores River Canyon. North and northwest of Cortez the project area consists of a high rolling plain with gently sloping hills, dissecting streams, and occasional steep-walled canyons. South of Cortez the area has deeply incised arroyos, overlapping alluvial fans, and remnant hills above the valley floor. Elevations decrease from 6,950 feet in the Dove Creek area to 5,000 feet near Towaoc.

Figure B-1 illustrates the geology and formation boundaries of the project area. Two sedimentary units are important in the project lands. Underlying southern Montezuma Valley and the Towaoc area is Mancos Shale, a gray to black, fossiliferous, brackish, nearly impervious marine formation with some minor sandstone interbeds. In Montezuma Valley the shale is highly fragmented. The upper zone of the formation is nearly always weathered and easily eroded, expressing a low, rounded topography.

1/ Nevin M. Fenneman, Physiography of Western United States (New York McGraw-Hill, 1931).



GENERAL GEOLOGY MAP
DOLORES PROJECT AREA
FIGURE B-1

SOURCE: GEOLOGY, STRUCTURE, & URANIUM DEPOSITS OF THE CORTEZ QUADRANGLE, COLO., UTAH by: D.D. Haynes, J.D. Vogel, & D.G. Wyatt... 1972

Dakota Sandstone is located immediately below Moncos Shale and forms the bedrock unit in northern Montezuma Valley and the Dove Creek area, where shale is missing. The formation consists of a buff to yellowish, thin-bedded to massive, river-deposited sandstone with some interbeds of carbonaceous shale and low grade coal. The basal member is often a coarser sandstone or conglomerate.

b. Project Features

(1) McPhee Reservoir

The Dolores River Valley at the site of McPhee Reservoir is incised into sedimentary rock formations (Figure B-1), the oldest of which is Entrada Sandstone of Middle Jurassic Age. This is overlain by the Morrison Formation, the Burro Canyon Formation, Dakota Sandstone, and Moncos Shale. The Burro Canyon Formation is poorly expressed and may be considered as a basal member of the Dakota Sandstone. The abutments of the dam would be located in strong, tight Entrada Sandstone, and the base would be founded in the slightly softer, but generally tight Carmel Formation.

The formations dip uniformly and gradually southward and are abruptly offset several hundred feet vertically by the inactive House Creek Fault (shown on Figure B-1). This normal fault trends northeast-southwest across the midportion of the reservoir basin and is downthrust on the north side. The only other major geologic structure nearby is the Dolores anticline, which lies adjacent to the east side of the reservoir site. A deeply seated fold, the anticline has almost no expression at the surface.

Three main types of overburden are found within the reservoir basin: stream deposits, rocky slopewash, and soil of mixed residual and eolian derivation. The stream deposits are sandy, gravelly, lenticular, and interfingered strata 15 to 24 feet thick. The riverbed has a cobble pavement, and the riverbank terraces generally have a thin, silty, sandy surface. The slopewash materials, found in alluvial fans and slope cover, consist of rock fragments mixed with eroded soils from higher elevations. The fans contain some indistinct talus zones and are generally interfingered with stream deposits. The slopewash overburden varies in composition, depending upon the rock formations exposed along the adjacent side slopes. The mixed residual and eolian soil is located primarily in the Great Cut arm of the reservoir site. In the lower elevations of this saddle, the soil is a gray residual clay derived from Mancos Shale. The gray soil thins out under a thickening cover of reddish silt at the higher elevations. Firm Mancos Shale and Dakota Sandstone would form the foundation of the dike.

(2) Monument Creek Reservoir

Monument Creek Reservoir would be located in a shallow depression in the upper portion of the Monument Creek drainage. Reddish eolian deposits of clayey and silty sand cover the entire site. No rock formations are exposed in the area, but Dakota Sandstone lies from 10 to 15 feet below ground at the dam site. Although the upper surface of the sandstone is quite irregular due to erosion, the interbeds indicate that the formation varies from lying nearly flat to dipping gradually to the southwest. The dip may be an expression of the deep-seated Dove Creek anticline, on whose south flank the site is located.

(3) Dawson Draw Reservoir

The Dawson Draw Reservoir site is a wide, shallow basin. Dakota Sandstone is the only formation expressed in the area and is visible as a cap rock near the dam site. A few remnants of Mancos Shale overlie the sandstone in the upper end of the reservoir basin. The inactive and tight House Creek Fault, tracing northeast-southwest, forms the south bank of the reservoir site and dissipates at the dam site.

Overburden in the reservoir basin consists of a 10-foot layer of sandy silt over about 10 feet of rock debris in a sandy matrix. The overlying silt is an accumulation of clays derived from Mancos Shale and mixed with reddish, eolian, silty sands from surrounding land above the site. The eolian soils were deposited in Dawson Draw Creek and modified during deposition by windblown particles and outwash from the adjacent slopes. The rock debris underlying the soil is comprised of remnants of Mancos Shale and Dakota Sandstone. This material thins out on the sideslopes and in the upper portion of the basin and is exposed only on the sideslopes at the dam site.

(4) Dove Creek and South Canals

Most of the Dove Creek Canal and all of the South Canal would be located in reddish, eolian soils underlain by Dakota Sandstone. Occasionally, the sandstone is overlain by a thin remnant of Mancos Shale or residual clay derived from the shale. The initial half mile of the Dove Creek Canal near Great Cut Dike would lie in occasional outcrops of Mancos Shale and gray, clayey soil derived from the shale.

(5) Dolores Tunnel and Dolores and Towaoc Canals

The divide through which the Dolores Tunnel would be constructed consists of Dakota Sandstone and the Burro Canyon Formation underlain by the Morrison Formation (shale and siltstone). A very small amount of ground water would be encountered, mostly as zones of dampness.

From the Dolores Tunnel to McElmo Creek, the Dolores and Towaoc Canals would cross deep, reddish, eolian soils underlain by Dakota Sandstone. The rest of the alignment around the eastern and southern base of Ute Mountain would cross alluvial fans of varied composition, intervening washes, and remnant ridges of Mancos Shale bedrock. Near the project land, the canal would cross a denuded exposure of Dakota Sandstone and terminate on a coarse fan.

c. Mineral Resources

A large sand and gravel industry has been operating within the McPhee Reservoir basin since 1946. According to the U.S. Bureau of Mines, small amounts of gold and magnetite (a common form of iron) are found in the sand and gravel beds.[1] Both these minerals originated near the headwaters of the river in the Rico Mountains.

The Morrison Formation, a known uranium producer to the north and west of the project area, crops out within the reservoir basin, but no economic deposits from the formation have been found or are expected to be found in the area. The Shinarump and Chinle Formations at depth beneath the Monument Creek Reservoir site may contain commercial uranium deposits, but the possibility is slight. Although the Ute Mountain Ute Indian Tribe has entered into a lease with an oil company for exploration and possible mining of uranium ore and associated minerals on the reservation, the results from the exploration are not yet available.

The Paradox Formation beneath the Monument Creek Reservoir site is known to contain extensive reserves of sodium chloride, but they are over 6,000 feet deep. Because of extensive reserves elsewhere that are closer to the surface, they have no present value.

Major reserves of coal are located in the Durango-Gallup coal field, whose northern border is approximately 8 miles south of Dolores. The coal is found in the Dakota Sandstone and the Menefee and Fruitland Formations. Shaley zones of Dakota Sandstone outside the McPhee Reservoir site contain thin seams of poor quality lignite coal, and the sandstone at the Monument Creek Reservoir site may contain some subbituminous coal. Outcrops elsewhere in the area are too thin to be mined.

Five oil and gas wells have been drilled in the vicinity of McPhee, and three wells have been drilled in the vicinity of Monument Creek Reservoir. No oil and gas was recorded in any of these holes, and all are considered to be dry and abandoned. A natural gas storage well in the McPhee Reservoir basin is served by a 2-inch pipeline.

d. Seismicity

The Dolores Project would be located in a zone of minimal seismic risk where only minor damage could be expected from earthquakes.[2] No known epicenters are within the area, but tremors from other areas may be felt. According to the National Geophysical and Solar-Terrestrial Data Center, the recorded magnitudes of earthquakes within a 100-mile radius of Cortez range from about 3.4 to 5.5 on the Richter Scale and

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1/ C. M. Harrer, Mineral Resources at McPhee Reservoir Site, Dolores Project, Montezuma County, Colorado (Bureau of Mines, August 1958). Bureau of Mines, Intermountain Field Operations Center, Denver, Colo., letter to Bureau of Reclamation, Durango, Colo. (July 14, 1975).

2/ Seismic Risk Map of the Western United States, U.S. Coast and Geodetic Survey, ESSA, from Algermissen (1969).

average about 4.[1] Recorded intensities on the modified Mercalli Scale are, in most cases, IV (usually no real damages). The last tremor felt, in January 1976, was of minor magnitude and occurred as a result of the removal of petroleum and gas from formations and their subsequent settling. The epicenter was located about 90 miles south of Cortez.

4. Soils

The supplemental service lands in the Montezuma Valley have been irrigated for over 70 years. In the southern part the soils originated predominantly from marine shales and sandstone, giving their gray color, their medium to fine (silty) textures with good water intake rates (0.9 to 1 inch/hour), and their moderately high salt content. The soils of the upper fans are generally shallow *3 to 4 feet) above cobble, while the flood plain soils generally extend to below 20 feet. In the northern part of the valley the soils are reddish-brown loam to light clay loam in texture, with good water intake rates and no salinity or alkalinity problems. The area is characterized by rolling topography with slopes of up to 12 percent. The soils are underlain by sandstone, varying from within 30 inches of the surface on the lower slopes to belwo 50 inches on the ridges. Because of topography and texture, drainage would not be a problem.

The soils in the eastern portion of the Towaoc full service area are gray to light yellowish-brown and similar in structure and depth to those in the southern part of Montezuma Valley. Although the soils have never been irrigated and are thus more saline, the area is bordered by arroyos generally over 15 feet deep, which should aid drainage and prevent a build-up of water tables and salts in the soils. The soils in the western part of the Towaoc area are predominantly reddish-brown and similar to those found in northern Montezuma Valley. They generally have uniform slopes of between 1 and 3 percent. Sandstone occurs below 8 feet, and in some areas cobbles occur below 24 inches.

The soils in the Dove Creek full service area, which is presently dry farmed, are similar to those in northern Montezuma Valley. They are reddish-brown, with medium textures and little or no profile developments. About 7 percent of this land has sandstone within 30-54 inches of the surface, and the rest has sandstone 54 inches or deeper. The irrigable lands in the dove Creek area are vely low in soluble salts and exchangeable sodium.

5. Water Resources

a. General

The project area involves two adjacent rivers both tributary to the Colorado River. The Dolores River flows along the northeastern

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[1] U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.

Table B-2

Summary of streamflows at selected points1/

(Rounded figures)

Station	Drainage area (square miles)	Annual runoff (acre-feet)			Range of daily discharge (second-feet)	
		Maximum	Average	Minimum	Maximum	Minimum
Dolores River Basin						
Dolores River						
At Dolores (1928-73)	504	614,300	298,600	94,400	10,000	8
At McPhee Dam site (1928-73*)	809	681,800	244,500	33,400	8,200	
At Bedrock (1917-22, 1971-74)	2,024	**	353,000	**	9,300	
At Cisco, Utah (1950-74)	4,580	1,086,000	507,000	164,100	17,400	3
San Juan River Basin						
Mancos River near Towaoc (1940-43, 1951-)	550	121,000	36,370	9,630	5,300	
McElmo Creek near Cortez (1951-)	342	60,450	33,250	14,830	3,040	0.1
San Juan near Bluff, Utah (1914-)	23,000	4,899,000	1,873,000	554,000	70,000	

1/ Water Resources Data for Colorado (Denver: USGS)

* Correlated flows using gauged flows at McPhee Site (1939-52), gauged flows at Dolores, (1928-73), and historic MVIC diversions.

** Insufficient years of record.

edge of the area and is the source of most of the water presently being used in the area. The San Juan River flows through northeastern New Mexico to the south of the project area, and its tributaries drain the area. The river is now regulated by Navajo Reservoir, located in New Mexico and Colorado to the southeast of the project area. The two major river systems are shown on the frontispiece map, and their flows are summarized in Table B-2.

b. Dolores River Basin

The Dolores River originates to the northeast of the area in the La Plata and San Miguel Mountains. Flowing at first to the southwest, it turns abruptly to the northwest just below the town of Dolores and continues in that general direction to its confluence with the Colorado River near Cisco, Utah. The tributaries in the vicinity of the project area are Beaver Creek and its tributary Plateau Creek, Lost Canyon Creek, and the West Dolores River. Beaver Creek and House Creek enter the river from the northeast about 1 and 4 miles above the proposed site of McPhee Dam, Lost Canyon Creek enters from the southeast at the town of Dolores, and the West Dolores River enters from the northwest about 7 miles upstream from the town of Dolores. The river annually discharges into the Colorado River an average of 507,000 acre-feet, or about 5 percent of the water which enters the lower Colorado River Basin at Lees Ferry, Ariz.

The average annual riverflows at the site of McPhee Dam are estimated at 244,500 acre-feet from 1928 through 1973. The river is very erratic, as Table B-3 illustrates, approaching flood proportions from melting snow in the spring and dropping sharply after midsummer. Approximately 36 percent of the flows occur during the month of May, and about 84 percent occurs during April, May, and June as a result of melting snow in the mountains. Daily fluctuations are even more severe; during about 14 out of every 15 years, the river dries up at the dam site sometime during the summer or fall.

Table B-3
Dolores River
Average monthly flows at
McPhee Dam site (1928-73)

Month	Flow (acre-feet)
January	3,200
February	3,100
March	10,400
April	61,900
May	87,900
June	54,900
July	6,400
August	3,100
September	2,500
October	4,500
November	3,200
December	3,400
Total	244,500

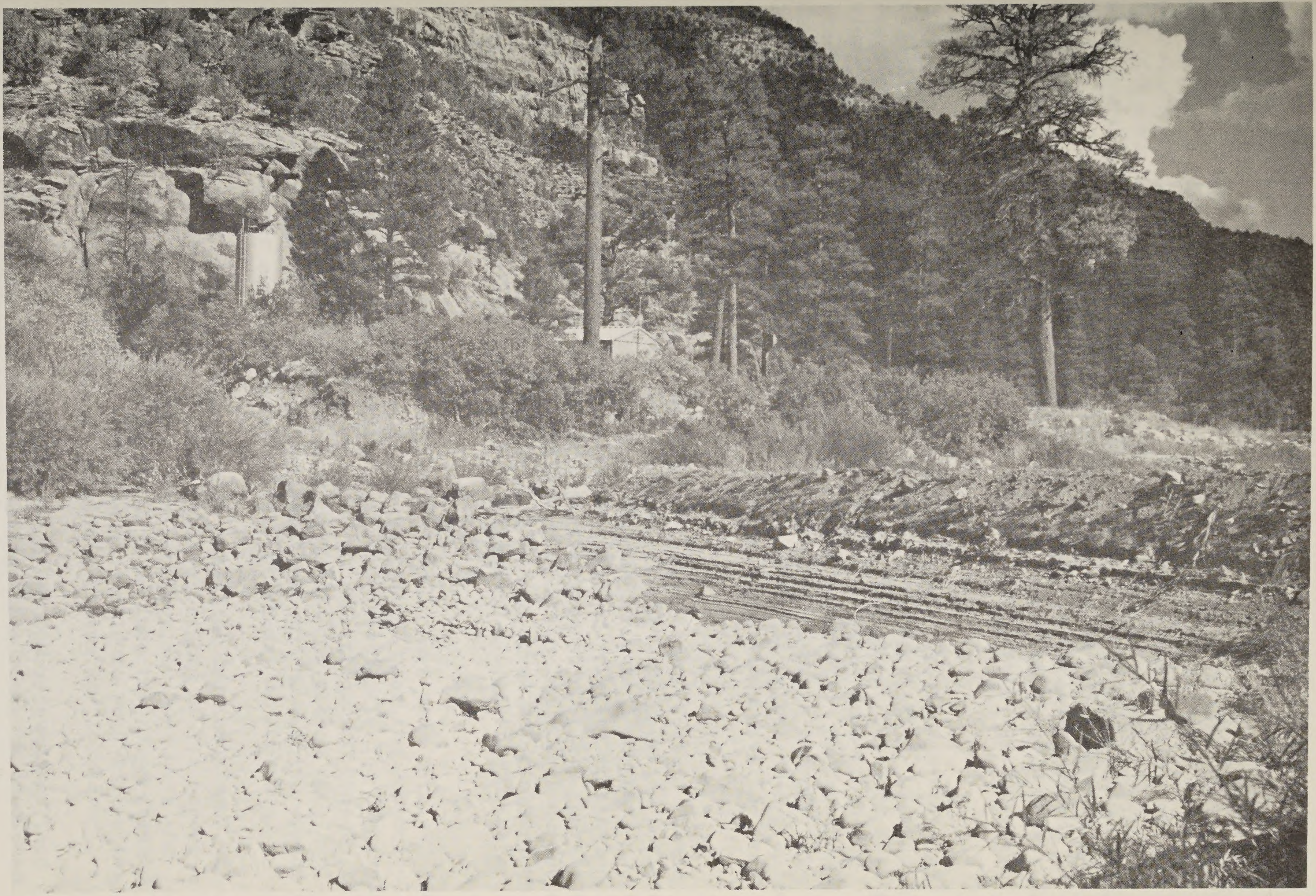

Figure B-2--Dry bed of Dolores River below McPhee Dam site in late summer.

The major user and distributor of Dolores River water is the Montezuma Valley Irrigation Company, which possesses an absolute diversion right for 707.7 second-feet to irrigate 46,000 acres of land, a conditional right for 592.3 second-feet to irrigate an additional 38,500 acres, and a right for the year-round use of 100 second-feet for stock, domestic, and industrial purposes. The company diverts an average of 116,000 acre-feet annually (1957-73) at a concrete diversion dam about a mile downstream from the town of Dolores, conveys the water into Montezuma Valley in the San Juan River Basin through a tunnel and a main canal, and distributes the flows to the users through an extensive system of canals and laterals. The Montezuma Valley Irrigation Company experiences shortages of about 13 percent of its annual irrigation requirements, usually in the late summer.

The Montezuma Valley Irrigation Company provides storage and regulation at three reservoirs in and near the project area. Groundhog Reservoir is located on Groundhog Creek, a tributary of the West Dolores River, and has a capacity of 21,700 acre-feet. Water from Groundhog Creek and Little Fish Creek is stored in the reservoir. Narraguinnep Reservoir, located about 10 miles north of Cortez, has a capacity of 19,000 acre-feet. Totten Reservoir, to the east of Cortez, has a capacity of 3,000 acre-feet. Both of the reservoirs store flows diverted from the Dolores River.

Municipal and domestic water for the city of Cortez, Towaoc, and two rural water districts is delivered through the existing Dolores Tunnel under a contract with Montezuma Valley Irrigation Company. Cortez obtains its water through the acquisition of four priority irrigation rights from the Dolores River Valley and the ownership of 120 shares of stock in the irrigation company (80 shares will provide 1 second-foot of water during the irrigation season). One of the rural water districts owns 100 shares of stock; the other purchases 10 second-feet of water on a year-round basis.

In the past, water supplies for Towaoc have been obtained from wells, springs, and infiltration galleries located near the community, but all of the sources were unreliable and insufficient. The Ute Indians now use part of their 200 shares of stock in the irrigation company to acquire a more adequate supply during the irrigation season when the water is available. The water is conveyed through the company system to a storage reservoir and treatment facility northeast of the town.

The town of Dove Creek obtains municipal and industrial water from the Dolores River Valley. Obtained under rights of 1.1 second-feet, the water is pumped through a head of about 950 feet over the Dolores-San Juan Divide from two wells drilled into the river gravels. During the low flows of summer, the town is unable to pump sufficient water and must purchase additional supplies, ration use, or both.

The Dolores River generally flows through undeveloped land below the project area, but some flood damage does occur on developed land such as agricultural land, irrigation facilities, residential areas, highways and utilities. The floods are of two types: (1) high spring flows caused by melting snow and (2) summer and fall flows from high intensity rainstorms that occasionally are combined with melting snow. The spring floods, occurring primarily in April and May, generally are longer in duration and larger in volume, but the rainstorms cause the higher peak flows. The Corps of Engineers estimates that damage occurs whenever the riverflows are 6,000 second-feet or greater on the reach from the site of McPhee Dam to the mouth of the San Miguel River (105 river miles) and 7,000 second-feet or greater on the second reach from the San Miguel to the confluence with the Colorado River (about 61 river miles).1/ During the 1928-73 study period, the flows at McPhee exceeded 6,000 second-feet on 14 days.

The Colorado Water Conservation Board has obtained an absolute water right with a priority date of May 1, 1975 on the planned minimum flows released from McPhee Reservoir. This right, for a maximum of 78 second-feet, pertains to the Dolores River from the reservoir to the confluence with the San Miguel River and, in effect, limits the use of the water to the preservation of the stream environment. The diversion and use of the minimum flow for other purposes is prohibited.

c. San Juan River Basin

The San Juan River orginates in the San Juan Mountains of Colorado, approximately 100 miles east of Cortez. Flowing in a westerly direction through New Mexico and the southwestern tip of Colorado to the south of the project area, it joins the Colorado River in southern Utah about 100 miles west of Cortez and about 200 miles downstream from the mouth of the Dolores River. The project area is drained by this stream's tributaries, most of which flow only intermittently from spring snowmelt and summer storms. Constant flows are found only in Yellow Jacket Creek and its tributary Dawson Draw, Navajo Wash, and McElmo Creek, all heavily dependent upon irrigation return flows.

Dawson Draw, originating to the north of Narraguinnep Reservoir, drains the northern tip of irrigated land in Montezuma Valley. Although the flows vary from year to year, the average volume is estimated at 4,500 acre-feet annually, as shown in Table B-4. The flows range from less than 1 second-foot to over 20 second-feet.

1/ U.S. Army Corps of Engineers, Benefits from Flood Control; McPhee Dam and Reservoir, Dolores River, Colorado (Los Angeles, October 1961).

Table B-4
Dawson Draw
Average monthly flows

Month	Flow (acre-feet)
January	160
February	140
March	390
April	330
May	570
June	850
July	620
August	550
September	180
October	230
November	320
December	160
Total	4,500

Navajo Wash is a tributary of the Mancos River, which originates in the La Plata Mountains to the east of the project area and flows to the southwest, joining the San Juan River near the northwestern corner of New Mexico. Although the upper portion of the river has permanent flows, irrigation diversions frequently deplete the lower portion, which has flows only during runoff from melting snow or summer thunderstorms or from Navajo Wash. The wash originates to the northeast of Towaoc and flows south for about 15 miles to its confluence with the Mancos. Return flows and canal waste from irrigation in Montezuma Valley provide flows during the summer and fall. The flows are highly variable, often exhibiting large fluctuations during a single day.

McElmo Creek originates in Montezuma Valley and flows toward the west, joining the San Juan River in southeastern Utah. Return flows from irrigation in the valley and from urban use in Cortez constitute much of the water in the channel.

d. Ground Water

Ground water resources are very limited. Existing wells yield less than 50 gallons per minute in the Montezuma Valley area and less than 10 gallons per minute in the Dove Creek and Towaoc areas.[1/] Depths to gound water vary considerably, from less than 50 feet along stream valleys to more than 500 feet on plateaus and stream divides. The volume of recoverable water in the upper 100 feet of saturated rocks is estimated to be less than 2 acre-feet per acre in the Montezuma Valley area and less than 0.5 acre-foot per acre in the Dove Creek and Towaoc areas.

1/ Colorado Water Conservation Board and United States Department of Agriculture, Water and Related Land Resources: San Juan River Basin; Arizona, Colorado, New Mexico, and Utah (Denver, June 1974).

6. Water Quality

Information on water quality is available for the Dolores River, McElmo Creek, Navajo Wash, the Mancos River, and the San Juan River. Man's activities have strongly influenced the quality of water, causing it to differ considerably at each of the sites. Attachment 1 contains tables on water quality.

a. Dolores River at Dolores

Immediately below the town of Dolores, the quality of the Dolores River is well within the U.S. Public Health Service and Colorado State drinking water standards. Samples collected by the Bureau of Reclamation from 1953 through 1960 contained total dissolved solids (TDS) in a flow-weighted average concentration of 127 milligrams per liter (mg/l). Depending upon the time of year, the concentrations varied from 79 to 352 mg/l.

The Colorado State Department of Health collected 36 water samples at Dolores from 1969 through 1975.[1/] Although its analyses indicated the presence of the heavy metals iron, zinc, and mercury and the toxic substances arsenic and selenium, none of these elements exceeded the recommended limits for domestic water.

Mining activity in the Rico area, about 40 miles upstream from Dolores, has historically introduced fluctuating amounts of heavy metals and toxic substances into the river. Although the quality of the water is poor near Rico, it improves downstream because of dilution by tributary streams and springs and the presence of alkaline soils. The concentrations of metals, toxic substances, and alkalinity undergo dramatic changes, and by the time the river reaches Dolores all of these factors are within the recommended standards for culinary use and can be readily handled by modern treatment processes. The towns of Dolores and Cortez have been treating and using the water for many years, with no apparent problems of treatment or health. The metals and toxic substances are not soluble in water with a pH of at least 7.5 and a hardness of about 250 mg/l,[2/] both of which have been recorded at Dolores (average pH of 8.1 and hardness of up to 265 mg/l.) These conditions, under which nearly all of the metals would precipitate, and the interaction of all the substances present should result in minimal problems of toxicity. The alkalinity of the water also decreases the threat of heavy metals to aquatic organisms, since the metals precipitate in forms that are unavailable for biological intake. Although certain fish and invertebrates do exhibit low levels of tolerance to certain dissolved metals and the levels may be periodically exceeded, two factors minimize this problem. Most of the metals are insoluble, and sustained exposure (a significant factor) does not appear to occur.

[1/] Provided by the Air and Water Surveillance and Analysis Division, Environmental Protection Agency, Denver, Colo.

[2/] Guy W. Harris, Jr., The Impacts of Various Metals on the Water Quality in Ridgway Reservoir (Bureau of Reclamation, July 1976), p. 8.

The turbidity, temperature, dissolved oxygen, and nutrient levels are within the limits necessary for a diverse and healthy biological system. Although not posing any problems, the levels of nutrients and coliform bacteria do reflect sewage discharges and urban runoff. High levels of organic pollutants are occasionally produced by washouts at the town of Dolores sewage treatment plant, which does not meet effluent standards, but such occurrences are not frequent or long in duration.

b. Dolores River Below Dolores

Diversions of the Montezuma Valley Irrigation Company, which sometimes deplete the entire flow during the irrigation season, are a major cause of deterioration in the quality of the river downstream from Dolores. Samples collected at Bedrock (about 105 miles downstream from the site of McPhee Dam) from 1971 through 1975 had an average TDS of 702 mg/l and a flow-weighted average of about 265 mg/l, with individual samples varying from 120 to 2,770 mg/l. The temperature and turbidity are also higher than near the town of Dolores because of lower flows, higher air temperatures, and the high susceptibility of the soils to erosion. The samples also contained some radioactive material, indicating uranium mining upstream.

Dissolved oxygen and pH concentrations are compatible with biological productivity, but high temperatures (32-85° F.) and turbidity could inhibit the productivity and diversity. High temperatures occur most of the year because of low flows and high turbidity. The turbidity, which is contributed largely by tributaries, is caused by natural erosion and human disturbances of the soil. Nutrient levels are moderate. Occasional high levels of phosphorus and fecal coliform indicate the presence of upstream sewage discharges but do not cause problems of eutrophication. Heavy metals and toxic substances are present in varying concentrations, primarily because of erosion. They would not prohibit the use of the water for livestock, although they would require extensive treatment for human consumption. Because of the temperature and chemical factors and their interaction, it is probable that heavy metals and toxic substances would remain in chemical forms unavailable for biological uptake.

c. McElmo Creek

Because of several factors, the quality of McElmo Creek is poor compared to that of the Dolores River.[1/] Studies by the Bureau of Reclamation indicate that return flows from irrigation and the presence of saline Mancos Shale in the drainage area contribute to high TDS concentrations, averaging 2,650 mg/l near Cortez and 2,880 mg/l near the Colorado-Utah State line. Near Cortez, sulfate varies from 870 to 3,000 mg/l, and calcium varies from 35 to 640 mg/l. The overall quality of the stream varies considerably because of fluctuations in the volume of the return flows.

[1/] The Air and Water Surveillance and Analysis Division of the EPA in Denver provided all information, with the exception of the TDS.

The water is basically alkaline (average pH 8.2) and has high turbidity levels and temperatures (32-81° F.). Man's influences are evident in the levels of nutrients found in this water. High nitrate and phosphate levels reflect water carried wastes and fertilizers originating from a variety of land uses. Concentrations of cyanide and selenium are greater than the recommended culinary water limits. Arsenic is also present but at minute concentrations. The alkalinity and other qualities of this water promote a condition whereby nutrients, heavy metals, and toxic substances are present in insoluble forms. A sample collected in September 1976 indicated that pesticide levels were well within the limits recommended by the Environmental Protection Agency.

Overall, the water is very saline and quite hard. The high levels of dissolved salts, turbidity, and temperatures create a harsh environment for many fresh water fish and invertebrates.

d. Navajo Wash

Flow in Navajo Wash is derived primarily from irrigation return flows during much of the summer and fall, and both the flow and turbidity fluctuate often, even within the same day.1/ The quality of the water is generally poor. Samples collected by the Bureau of Indian Affairs since 1968 have had TDS concentrations ranging from 6,330 mg/l during low flows to 1,980 mg/l during high flows. Pesticide levels are within the recommended limits, according to a sample collected in September 1976.

e. Mancos River

The Geological Survey sampled the Mancos River near Towaoc from December 1972 through August 1973.2/ Fluctuating according to the streamflow, the concentration of TDS varied from 328 mg/l during the high flows of June to 1,780 mg/l during the low flows of December. The only constituent exceeding the recommended limits for drinking water was sulfate, which reached 930 mg/l. Pesticide levels are within acceptable limits.

f. San Juan River

During the 1972-73 program, the Geological Survey also collected samples from the San Juan River at the Colorado-New Mexico State line.2/ The TDS concentrations varied from 242 to 554 mg/l, and the only constituent that exceeded the limits for drinking water was sulfate, with a high recording of 280 mg/l. Pesticides and bacteria were acceptable, although one sample had a fecal coliform count at the upper limit for domestic water.

1/ Buddy Lee Jensen, Fishery Management Biologist, Dolores Project Investigations: Ute Mountain Ute Indian Reservation, Colorado and New Mexico (U.S. Fish and Wildlife Service: Gallup, N. Mex., January 30, 1975).

2/ George H. Leavesley, Quantity and Quality of Principal Rivers Entering the Southern Ute and Ute Mountain Ute Indian Reservations, Colorado and New Mexico (U.S. Geological Survey: Lakewood, Colo., 1975).

g. Ground Water

The TDS concentrations of ground water in the project area vary from about 250 to 3,000 mg/l. In the lower elevations of the McElmo Creek drainage, the salinity is between 250 and 1,000 mg/l; in the rest of the area it varies from 1,000 to 3,000 mg/l.

7. Vegetation and Land Use[1]

a. General

In Montezuma and Dolores Counties vegetation reflects the changes in elevation and precipitation, which generally increase from southwest to northeast. The corresponding vegetative communities are salt desert shrubs, grass lands, irrigated and dry crop lands, pinon-juniper wood lands, intermountain wood lands, mountain shrubs, and coniferous forest. Riparian vegetation, found along all of the streams in the area, varies locally according to characteristics of streamflow, soil, and climate. Figure B-3 illustrates the distribution of the communities in the area.

The major agricultural uses of the land are farming, grazing, and forestry. Range management often depends upon the irrigated lands in the area to furnish additional feed. Wildlife habitat and recreation are also major uses of land and are generally compatible with other uses. Mining, transportation, utilities, and urban areas occupy a small percent age of the land area.

(1) Salt Desert Shrubs

Located at an elevation of 6,000 feet or less, the salt desert shrub community occurs primarily along the Mancos River in southern Montezuma County. Greasewood, rabbitbrush, and tamarisk are commonly found in the hot, dry climate in areas with high, usually alkaline, water tables.

(2) Grass Lands

A sparse, semidesert grass land community, varying in elevation from 4,800 to 6,000 feet, characterizes most of southwestern Montezuma County, including all of the project land in the Towaoc area, and also occupies an area east of Cortez. Yucca and prickly pear cactus are common wherever the land has been disturbed. Forbs indicate disturbances at all elevations but usally decrease as the grasses become reestablished. Grazing of livestock is the primary use made of this vegetative community.

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[1] Sources: Colorado Water Conservation Board and United States Department of Agriculture, Water and Related Land Resources: Dolores River Basin, Colorado and Utah (Denver: September 1972), pp. III-17 - III-35.

Colorado Water Conservation Board and United States Department of Agricultures, Water and Related Land Resources: San Juan River Basin: Arizona, Colorado, New Mexico, and Utah (Denver: June 1974), pp. III-31 - III-48.

H. E. Owen, Final Vegetative Inventory Report for the Dolores Project (Durango, Colo.: August 1, 1974), 31 pp.

Colorado State University Rapid Access Plant Information Center (RAPIC) July 19, 1976.

(3) Irrigated and Dry Crop Lands

Irrigated crops (at 5,500 to 7,500 feet) are grown primarily in the Montezuma Valley area, where the project supplemental service land is located, and smaller irrigated areas are located along the Dolores River and to the east of the project. The major vegetation is alfalfa, meadow hay, and pasture.

Dry crop land, generally between elevations of 6,500 and 7,500 feet, is found in northwestern Montezuma County and western Dolores County. Encompassing all of the project land in the Dove Creek area, this vegetative community consists of pinto beans, winter wheat, and scattered islands of pinon-juniper wood land.

(4) Pinon-Juniper Wood Lands

Extensive stands of pinon pine intermingled with Utah and Rocky Mountain juniper are found along canyons and in mountain areas between 5,000 and 7,500 feet. Varying from open to dense, the stands often grow among rocky surfaces and outcrops that limit the understory to forbs and grasses. This community is characteristic of the canyons and other uncultivated parts of the Dove Creek area and forms the western border of the irrigated Montezuma Valley area.

(5) Intermountain Wood Lands

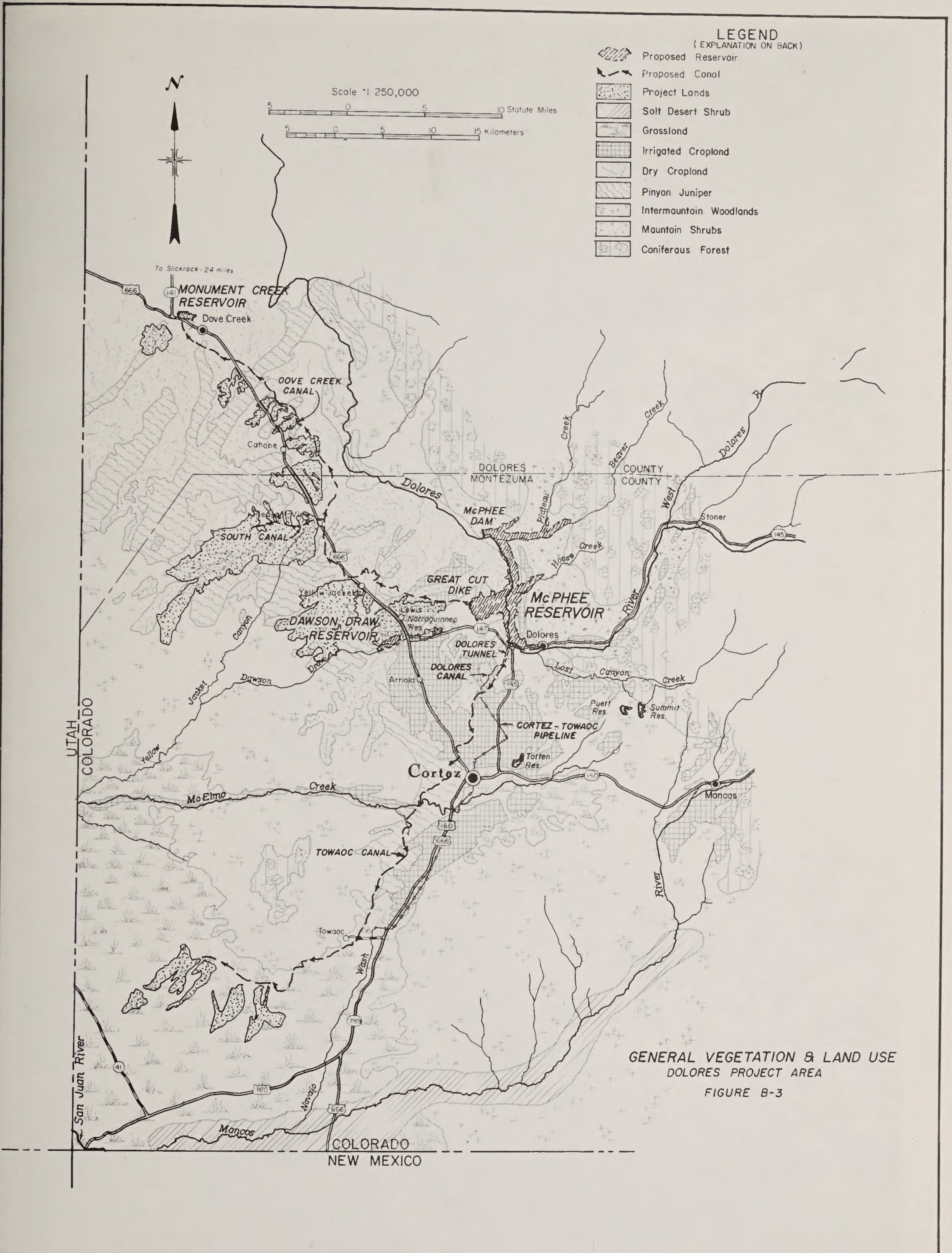
Found between 6,000 and 8,000 feet in elevation, this wood land consists of pinon pine and juniper with a brushy understory of bitterbrush, big sagebrush, mountain mahogany, cliffrose, and Gambel's oak. Forbs and grasses are also found in the understory. This community marks the southern boundary of the Dove Creek area and the eastern boundary of the Montezuma Valley area.

(6) Mountain Shrubs

The mountain shrub community, composed mainly of Gambel's oak, is found at elevations of 6,000 to 8,000 feet on the northeast side of the project area and occupies a transitional zone between grass lands and coniferous forest. The shrubs also replace stands of ponderosa pine removed by logging or fire. Grasses form the understory of the community.

(7) Coniferous Forests

Forests of ponderosa pine intermixed with scattered stands of Douglas fir are found to the northeast of the project service area between 6,000 and 9,500 feet. The coniferous forest often consists of open stands



GENERAL VEGETATION & LAND USE
DOLORES PROJECT AREA
FIGURE B-3

ADAPTED PRIMARILY FROM: Land Use Maps, Dolores & Montezuma Counties, SCS 1973

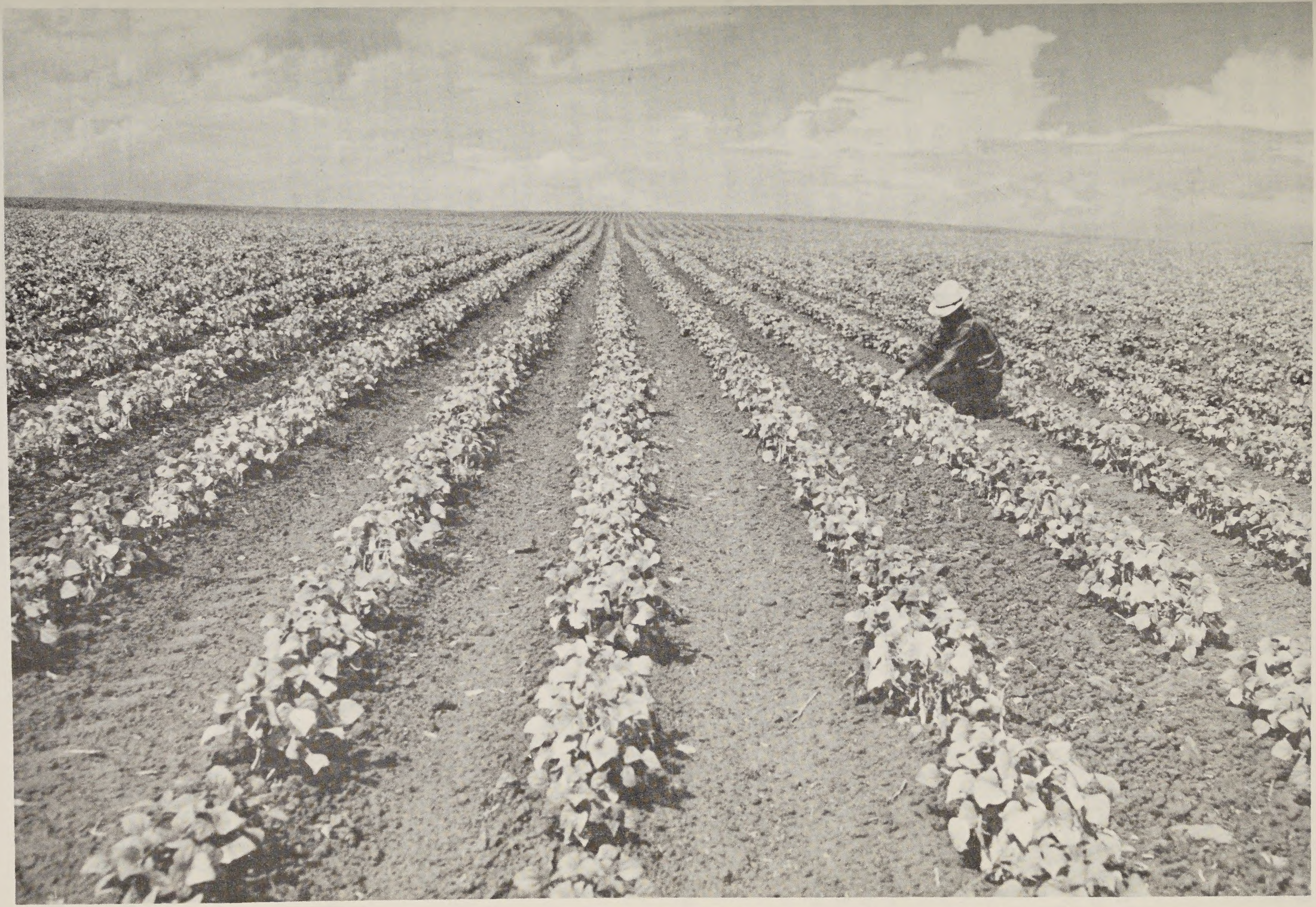


Figure B-4--Rows of pinto beans on dry farm land in Dove Creek area.

that permit an extensive herbaceous understory and is often interspersed with grass lands. On northern slopes, however, the timber is often very dense, and the lack of sunlight retards the development of an extensive understory.

(8) Riparian

The Dolores River has a parallel zone of riparian vegetation. The dominant species are cottonwood and box elder trees interspersed with dense growths of willows, alder, and hawthorne. Forbs and shrubs make up the understory.

b. Project Features

About 14,746 acres of land would be acquired for McPhee Reservoir and associated developments. As Table B-5 shows, pinon-juniper wood land is the most extensive community in the area, followed by irrigated crop land and grass land. Part of the site, consisting of the river channel, rocky waste land, and a gravel pit, supports no vegetation. At the site of Monument Creek Reservoir, the vegetation consists of dry crop land, seeped pasture, and native grass land. Dawson Draw Reservoir would be located in an area now characterized by grass land and marsh, with a small amount of irrigated pasture and pinon-juniper wood land.

The proposed rights-of-way for the Dove Creek and South Canals would contain about 580 acres of land, consisting of crop land, pinon-juniper wood land, and intermountain wood land. The Dolores and Towaoc Canals contain 750 acres of irrigated crop land, grass land, pinon-juniper wood land, and intermountain wood land.

c. Threatened and Endangered Plants

Five plants within the general vicinity of the project are included on a proposed list as endangered.[1] Four of these (Acer grandidentatum, Astragalus humillimus, Astragalus schmollae, and Sclerocactus mesa-verdae) are found only in Mesa Verde National Park outside the project area.[2] The other plant (Atreplex pleiantha), has been identified and collected only once, on June 12, 1949, by W. A. Weber. Found about 10 miles south of the project land in the Towaoc area, the specimen was located in a Mancos Shale area on the reservation.

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[1] Endangered and Threatened Wildlife and Plants, Federal Register, Vol. 41, No. 115, Part II (Monday, June 14, 1976) pp. 24062-24067, and Vol. 41, No. 117, Part IV (Wednesday, June 16, 1976), pp. 24524-24572.

[2] Stanley L. Welsh and James A. Erdman, Annotated Checklist of the Plants of Mesa Verde, Colo., Biological Series Vol IV, No. 2 (Provo, Utah: Brigham Young University, April 1964).

Table B-5
Vegetative communities at reservoir sites
(acres)

	McPhee		Monument Creek		Dawson Draw	
	a	b	a	b	a	b
Grass land	816	1,661	6	42	219	682
Irrigated crop land	989	2,013			2	118
Dry crop land	197	810	46	260		
Pinon-juniper	1,619	8,666				10
Riparian	448	969				
Seeped pasture			32	70		
Marsh					73	262
River channel	240	270				
Waste land	75	189				
Gravel pit	86	168				
Total	4,470	14,746	84	372	294	1,072

Vegetative communities at canal sites, tunnel,
Cortez-Towaoc pipeline and Dolores River recreation sites

	Dolores and Towaoc Canals	South Canal	Dove Creek Canal
Intermountain wood land	44		41
Irrigated crop land	150		71
Pinon-juniper	250		101
Grass land	306		
Dry crop land with scattered pinon-juniper		95	270
Total	750	95	483

Dolores Tunnel		Cortez-Towaoc Pipeline		Dolores River recreation sites	
Pinon-juniper	3	Pinon-juniper	6	Riparian	78
		Dry crop land	7		
		Irrigated crop land	10		
		Waste land (Existing highway right-of-way)	48		
			71		

a. Within the high water surface.

b. Within the takeline (right-of-way), including the area within the high water surface but excluding wildlife and scenic easements.

8. Fish and Wildlife

a. Fish and Aquatic Invertebrates

(1) Dolores River[1]

Above the town of Dolores, the Dolores River is a cool mountain stream supporting a trout fishery, although man has altered the habitat. Spills from mine tailing ponds adversely affected the river in the past, but the present evidence of aquatic organisms is an indication of recovery. Below the town of Rico, which is about 40 miles upstream from Dolores, the river has undergone channelization for flood control and associated gravel mining, which has disrupted fish spawning, resting, and food producing areas.

The Colorado Division of Wildlife annually stocks about 8,000 catchable rainbow trout in the mainstem of the river above Dolores and approximately 16,000 in the West Dolores River. Fisherman use for the entire upper portion of the river is estimated at 21 to 28 fishermen per river mile per year, for an annual use of 1,281 to 1,708 fishermen days. Other species of trout present in the upper Dolores River include eastern brook trout, brown trout, and cutthroat trout which enter the river from its tributaries. Nongame fishes inhabiting the upper Dolores include species such as the mottled sculpin (the most abundant), flannelmouth sucker, bluehead sucker, speckled dace, brassy minnow, and fathead minnow.

Below the diversion facilities of the Montezuma Valley Irrigation Company 1 mile south of Dolores, where the river has reduced flows and warmer temperatures, sport fishes are rare. Although the Colorado Division of Wildlife stocked 6,600 fry and fingerling trout between Dolores and the Utah State line in 1971 and 1973, the success of the program is unknown. In a 1973-74 survey, the only sport fish observed were several brown trout downstream from the diversion dam and a channel catfish at Slick Rock. The speckled dace and flannelmouth sucker are abundant in the lower portion of the river. The black bullhead, brassy minnow, fathead minnow, roundtail chub, red shiner, and carp are also common.

Aquatic invertebrates, an important source of food for fish, are found in all reaches of the river. Mayfly, stonefly, and caddisfly larvae, which are indicative of cool water temperatures and high oxygen levels, have been collected above Dolores, as have cranefly larvae, water mites, midges, and beetles. Mayfly, stonefly, and cranefly larvae are also present between Dolores and Slick Rock.

Tributaries of the river in the project area do not generally have sufficient flows to support fish. Surveys conducted during August 1976 revealed that Dry Canyon and House Creeks were dry and that Beaver

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[1] Colorado Division of Wildlife, Fish and Wildlife Analysis for the Dolores Water Project (September 1973 to June 1974), pp. 107-123.

Creek contained a negligible flow above its confluence with Plateau Creek. Plateau Creek and Beaver Creek below the confluence had a flow of 0.5 second-foot. Species found in these sections consisted of a small number of speckled dace in Plateau Creek and a large number of young-of-the-year roundtail chubs in Beaver Creek. The low flow, warm temperatures, and excessive silt have prohibited the development of a sport fishery.

(2) San Juan River Basin

The major streams providing flows to support fish in the San Juan Basin portion of the project area are the San Juan River, Navajo Wash, the Mancos River, and McElmo Creek. In late September and early October 1974, the Fish and Wildlife Service conducted field investigations on the Ute Mountain Ute Indian Reservation, including part of the San Juan River, Navajo Wash, and part of the Mancos River.[1] All of the streams contain minimal populations of game fish because of low flows, frequent changes in flow, sediment loads, and warm temperatures. The Mancos River above Navajo Wash was dry during the study. No collections were made on McElmo Creek.

A total of 43 fish were collected in the San Juan River, consisting of fathead minnows, red shiners, carp, and a single flannelmouth sucker. The only live stream section located on the Mancos River was below the confluence with Navajo Wash, which contributes approximately 1 second-foot of water. The sample taken on this section revealed populations of fathead minnows, red shiners, and roundtail chubs. Flows in Navajo Wash fluctuate frequently due to intensive agricultural use of water on the upper watershed. During the fisheries inventory, volumes of flow ranged from 1 second-foot at the confluence with the Mancos River to 5 second-feet at the upper end. Daily changes in flow and turbidity are common. A total of 427 fish was collected from this stream, consisting of speckled dace, fathead minnows, flannelmouth suckers, bluehead suckers, roundtail chubs, red shiners, and carp.

Caddisflies, dragonflies, mayflies, midges, and nematodes were collected from Navajo Wash and the San Juan River. The sample taken on Navajo Wash at its junction with the Mancos River is probably indicative of stream productivity throughout the area. Square foot bottom samples were collected at three locations on the wash, and productivity was poor due to conditions previously mentioned. An average of 36 organisms comprised a volume of 0.4 cc per square foot of bottom sampled. Sampling of aquatic inverebrates in the San Juan River also revealed limited productivity, with 110 organisms comprising a volume of 0.5 cc per square foot sampled.

An additional study, funded by the Fish and Wildlife Service to determine the status of endangered fish species in the San Juan River, revealed species that were not reported in the October 1974 study.

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[1] Buddy Lee Jensen, Fishery Management Biologist, Dolores Project Investigation: Ute Mountain Ute Indian Reservation, Colorado and New Mexico (U.S. Fish and Wildlife Service, January 30, 1975.)

These fishes, which were collected in the San Juan River from Navajo Reservoir to Lake Powell, include the black bullhead, channel catfish, bluehead sucker, speckled dace, smallmouth bass, green sunfish, rainbow trout, brown trout, mosquito fish, and Rio Grande killifish.

b. Wildlife

(1) General

Information on the wildlife resources of the Dolores Project area has been collected from several different sources through cooperative agreements with the Bureau of Reclamation. In 1974, the Colorado Division of Wildlife completed a report entitled "Fish and Wildlife Analysis for the Dolores Project Area." The report presents an inventory of the game and nongame terrestrial and aquatic wildlife resources on non-Indian lands in the project area. The report also predicts the impacts on the various species which would be affected by the project. Wildlife within that portion of the Ute Mountain Ute Indian Reservation affected by the project was inventoried by the Fish and Wildlife Service. One report by the Service covered the aquatic wildlife on the reservation, and a second was concerned only with the terrestrial wildlife. An additional report by Dr. Preston Somers of Fort Lewis College in Durango, Colo., inventoried the amphibian and reptiles in the project area. A complete list of all wildlife species found in the area, including habitat types, population, and seasonal occurrence, is available for inspection at the Bureau of Reclamation Regional Office in Salt Lake City, Utah.

(2) Big Game Mammals

(a) Mule Deer

Since around 1900, much of the winter range that supported mule deer in the project area has been converted to farm land and other uses. Historic migrations have also been changed by man-made barriers such as fences, roads, and highways. The mule deer is still found in the area but only in certain portions of its former range. The deer populations use different seasonal areas classified as summer range, spring-fall range (migration routes), and winter range.

Two distinct populations of deer inhabit summer ranges in the project area; one that summers north of the Dolores River and one that summers in and around Mesa Verde National Park. The population north of the Dolores River inhabits land generally above 8,000 feet in the San Juan National Forest. There is an abundance of range, and the deer are widely scattered throughout the forest. The Mesa Verde population summers at elevations above 7,000 feet, where the vegetation is predominantly intermountain wood land. This range is drier than that on the National forest, and deer seek water from intermittent springs and streams in the late summer.

During the fall, heavy snow at high elevations forces the deer to lower areas where food is available. This spring-fall range, which is used during migrations, varies in elevation from 6,500 to 8,000 feet and is composed of the coniferous forest, intermountain wood land, and mountain shrub vegetative communities. During the spring, when the deer move up from their winter range, the spring-fall range serves as a fawning ground, particularly in the regions of House Creek, Narraguinnep Canyon (located about 10 miles downstream from the proposed McPhee Dam), and Summit Reservoir (located about 8 miles southeast of Dolores).

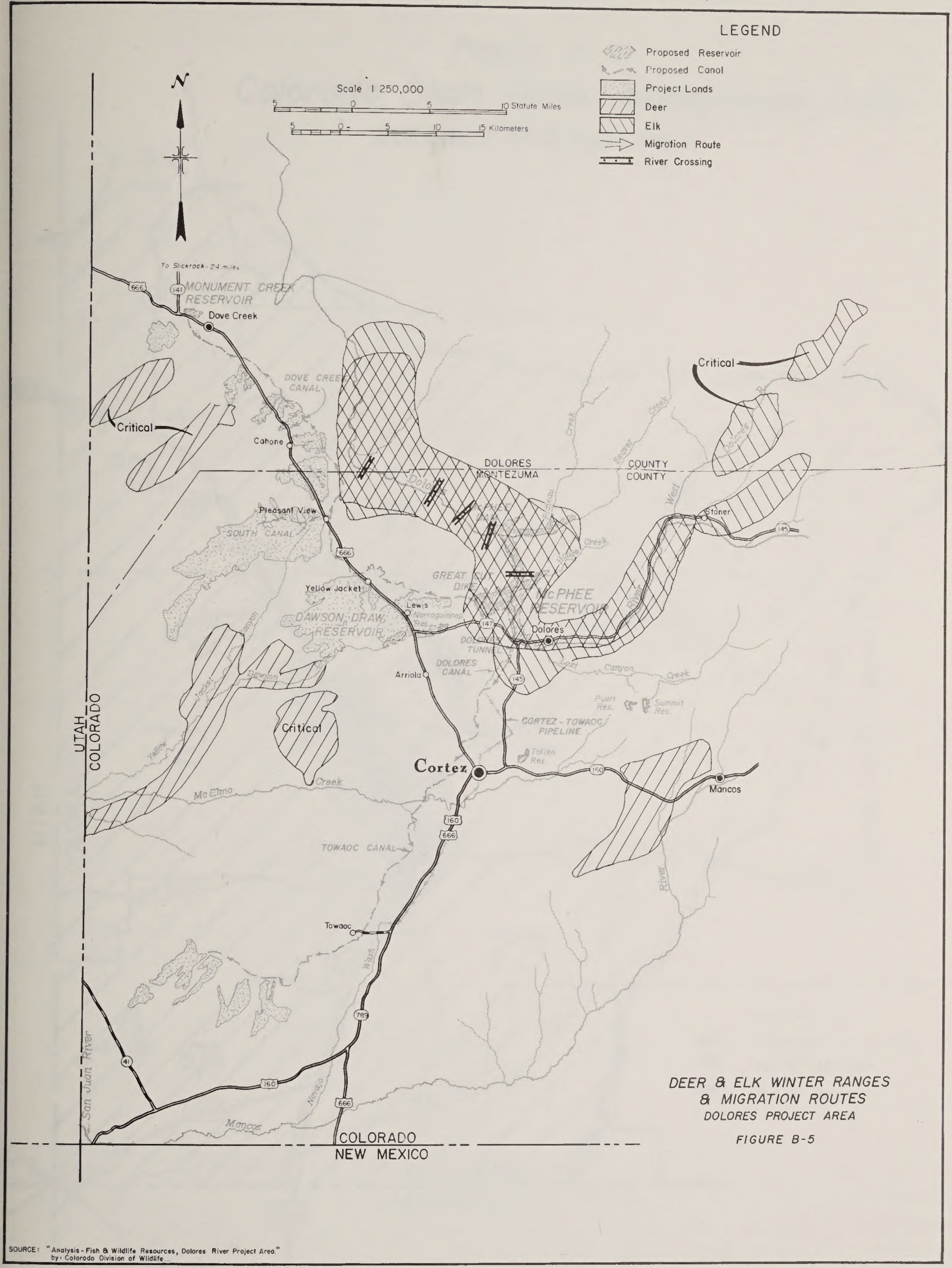
Winter range for deer, shown in Figure B-5, is normally found at elevations below 7,000 feet. Nearly half of the deer in the project area winter in the Dolores River Canyon from Stoner to Dove Creek. During migration, most deer move off the National forest directly into the canyon. As the winter progresses, some continue moving south and west onto the smaller wintering areas, and additional deer may be forced from the Dolores Canyon into these areas during winters of heavy snowfall. Because of this concentration, these areas are designated as critical winter range. Another heavily used winter range is found along U.S. Highway 160 east of Cortez, where deer from the upper Dolores River and Mesa Verde are found from December until April. Winter ranges are also located along Cross and Yellow Jacket Canyons at lower elevations, where there is a mixture of crop land and native vegetation.

The Colorado Division of Wildlife estimates that about 10,000 deer inhabit game management units 71, 72, and 73, encompassing Montezuma and Dolores Counties and generally along the Dolores River Valley to Slick Rock, Colo. (shown in Figure B-6). The average annual harvest was about 2,600 deer from 1969 through 1973. The winter population of deer occupying the McPhee Reservoir site has been estimated at 450 animals. The management goal is to maintain a stable population, with a slight increase in the western part of the area.

(b) Elk

Elk summer range in the Dolores River drainage lies almost entirely on the San Juan National Forest, at elevations of from 7,800 to 14,000 feet. The habitat consists of coniferous forest interspersed with patches of aspen and large open parks. These parks consist of a variety of high altitude grasses, sedges, willows, and herbaceous forbs. In general, this range coincides with that of deer, although the elk band together rather than dispersing like deer. Because of the large amount of summer range available, it is not considered a limiting factor to the elk population.

The elk spring-fall range is relatively small compared to the deer range and normally includes the lower portion of their summer range and the upper portion of their winter range, generally located on the National forest between 7,500 and 8,000 feet. The area is within the coniferous forest community, which provides food and cover as the elk move down from their summer range because of snow accumulations. In the spring, calves are born as the elk follow the snowline upward toward their summer range. No calving areas were found near proposed project features.



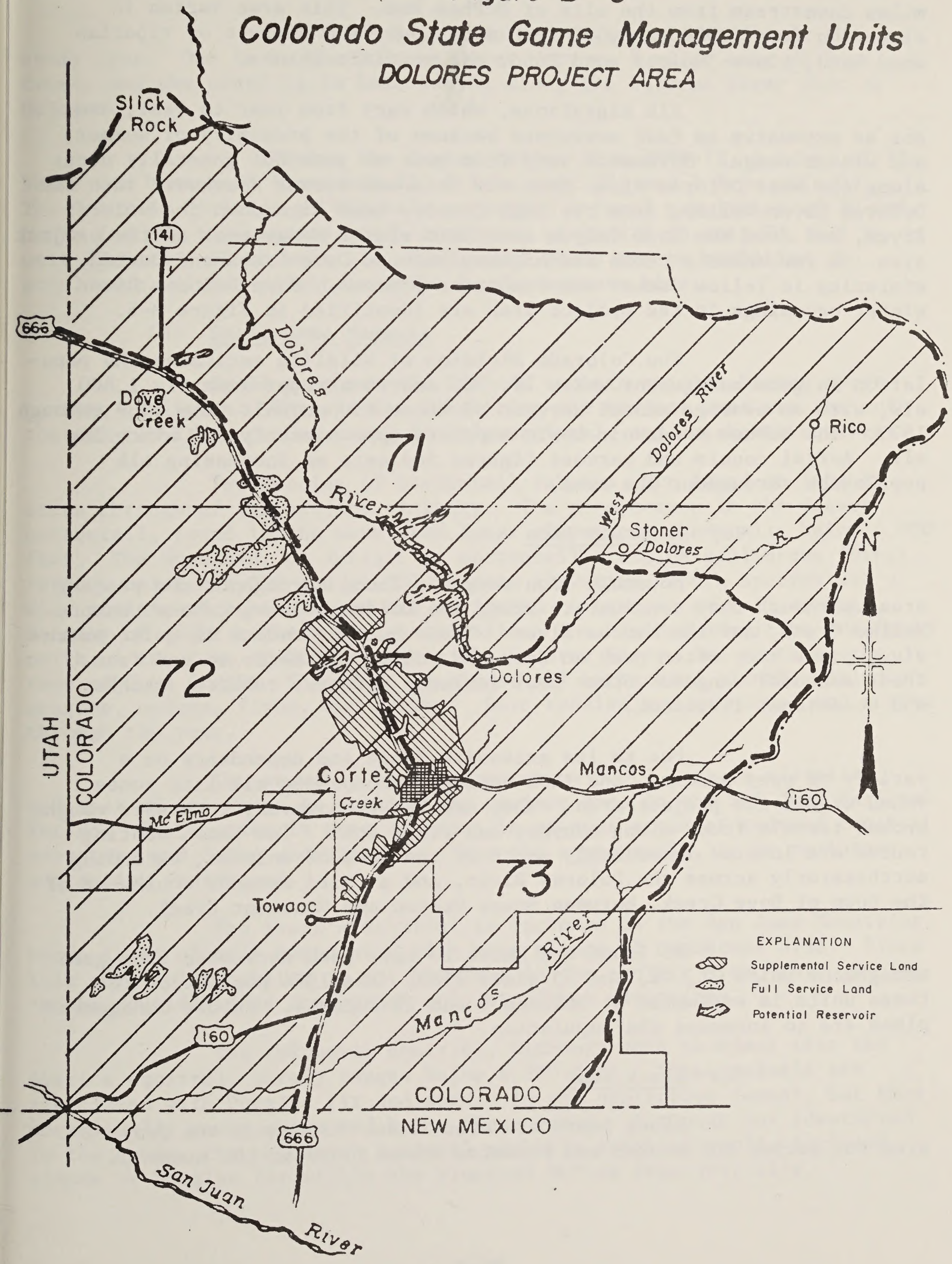
DEER & ELK WINTER RANGES & MIGRATION ROUTES
DOLORES PROJECT AREA
FIGURE B-5

SOURCE: "Analysis - Fish & Wildlife Resources, Dolores River Project Area."
by: Colorado Division of Wildlife.

Figure B-6

Colorado State Game Management Units

DOLORES PROJECT AREA



Winter range, shown in Figure B-5, lies between 6,500 and 9,600 feet, concentrated in six distinct areas. Most of the elk are concentrated along the Dolores River from Stoner to about 15 miles downstream from the site of McPhee Dam. This area varies in elevation from 6,500 to 7,500 feet and supports a mixture of riparian wood land, pinon-juniper wood land, and mountain shrubs.

Elk migrations, which vary from year to year, are not as extensive as deer movements because of the proximity of summer and winter range. Movements vary from year to year but generally occur along the West Dolores River from the National forest southward into the Dolores River Valley, from the high country near Rico down the Dolores River, and from the Lost Canyon area into winter range east of the project area. A few animals cross the highway between Dove Creek and Cortez, wintering in Yellow Jacket and Sandstone Canyons. Five Dolores River winter crossings in the project area are identified in Figure B-5.

The Colorado Division of Wildlife estimates the population in game management units 71, 72, and 73 at approximately 1,800 elk, with an average annual harvest of about 650 animals from 1969 through 1973. The McPhee Reservoir basin supports approximately 300 wintering elk. Aerial counts and harvest figures indicate an increasing elk population throughout the area.

(c) Mountain Lion

Mountain lion range is found throughout the project area, although they concentrate along the Dolores River, Cahone Canyon, McElmo Creek, and the Mancos River. Their hunting radius is quite extensive, since they often prey on deer and follow the herds to and from their seasonal ranges. Other prey includes rodents, rabbits, skunks, and occasional livestock.

Due to its extensive range and dependence on a variety of prey species, the lion habitat encompasses all life zones found within the project area. They are known, however, to prefer rough, broken terrain found along canyons and ridge tops. Two known hunting routes are located immediately south of the town of Dolores, extending northeasterly across the Dolores River, and a third extends southwest of the town of Dove Creek, between Squaw Canyon and Monument Creek.

No lions are known to have been harvested from game management units 71, 72, and 73 since 1965. The 1974 population for these units is estimated at between 5 and 29 animals. Future management plans are to increase the population.

(d) Black Bear

Black bears are also found throughout the project area but prefer the brushy and forested areas found in the numerous canyons. Because of hibernation and limited range, they do not follow a seasonal migration. Bears are omnivorous, and foods include carrion, fresh meat, insects, fruits, nuts, berries, and various plants.

Two areas of concentration were located near the study area. One is in the Dolores River Canyon, 8 miles east of Dove Creek, and the other is in Lost Canyon along the Dolores River east of Dolores.

During the 5-year period from 1969-73, a total of 22 bears was harvested from unit 71, 4 from unit 72, and 4 from unit 73. The Colorado Division of Wildlife estimates a total population of 30-464 bears for the three units, with estimates of 24-420 in unit 71, 0-5 in unit 72, and 4-40 in unit 73. Management goals are to stabilize the population, with a slight increase in the western area.

(3) Small Game Mammals

Small game mammals include certain species having sport-hunting qualities. The species inhabiting the project area are the cottontail rabbit, snowshoe hare, Abert's squirrel, and chickaree squirrel.

Two species of cottontail rabbits were found to inhabit areas throughout the project vicinity. The more common is the desert cottontail, found in the more arid lower elevations, generally below 6,000 feet. The mountain, or Nuttall's, cottontail occupies coniferous forest regions between 6,000 and 11,000 feet in elevation. Both species use a wide variety of habitats and are estimated to have an overall average density of eight rabbits per square mile. The highest densities are found north of the town of Cortez, along the Dolores River, and south of the town of Dove Creek. They feed on almost all herbaceous plants, including grasses, sedges, forbs, and shrubs. Both species are nocturnal and active through the year.

The snowshoe hare occurs above 8,000 feet in elevation, and most of its range is outside the project area in the San Juan National Forest. The species is most abundant in or near areas of reduced conifer overstory and dense undergrowth. Like the cottontails, it is nocturnal and active year-round.

The Abert's squirrel is uncommon in the San Juan Mountains, where it is closely associated with pure stands of ponderosa pine. Since this particular habitat is not abundant in the project area, this species can be considered as occasional only at higher elevations.

The chickaree squirrel, although more abundant than the Abert's squirrel, rarely ranges below 6,000 feet. These animals are associated with Douglas fir and spruce in the coniferous forest, but they occasionally range above and below these zones. Although not identified in the study, the chickaree squirrel probably inhabits small, isolated stands of Douglas fir within the proposed McPhee Reservoir site.

(4) Furbearers

Furbearers inhabiting the project area include the beaver, striped skunk, spotted skunk, muskrat, mink, short-tailed weasel, long-tailed weasel, gray fox, ringtail, badger, and kit fox.

The beaver concentrates along the Dolores and Mancos Rivers in the study area. The distribution of the animal is restricted by its food sources, which generally include aspen, willow, and cottonwood. Beaver populations in the area are estimated to be 800. Trapping is relatively light.

The striped skunk is common throughout the area, inhabiting a variety of habitats. Its range in the area is large, extending from the Ute Mountain Ute Indian Reservation to the upper portion of the Dolores River. The spotted skunk occurs in the project in lesser numbers and tends to prefer the canyons and more arid river valleys at lower elevations. The population is estimated at 800 in the study area, primarily in regions south of Dolores.

Suitable muskrat habitat, consisting of streams, lakes, ponds, swamps, and irrigation ditches, is common in the study area. Distributed in the Dolores River Basin from Groundhog Reservoir southward and from Rico to the McPhee Reservoir site, the animals inhabit burrows dug in the streambanks or small lodges constructed of aquatic vegetation and mud. They are estimated to number 640 and are concentrated in marshy areas along Dawson Draw, Narraguinnep Reservoir, Totten Reservoir, Denny Lake (located on the eastern edge of Cortez), and the McPhee Reservoir site.

Mink inhabit areas in and near marshes, ponds, lakes, and streams. Normally active at night, they are carnivorous and may prey on a variety of animals, ranging over great distances in search of food. No specimens were identified during the survey, and the animals are considered to be uncommon in the area, although habitat exists on streams leading into the McPhee Reservoir site from the northeast.

Of the two species of weasel found in the study area, the ermine, or short-tailed weasel, is restricted to the higher elevations in Montezuma and Dolores Counties and prefers coniferous forest and mountain shrub habitats. The more common long-tailed weasel is found in virtually all habitats in the area except very moist ones. Although its range is fairly extensive, areas of concentration are found near the upper portion of the West Dolores River and on both sides of the Dolores River from the McPhee Reservoir site to Dove Creek. An estimated 200 weasels inhabit the study area, most of which are found north of the Dolores River.

The gray fox is fairly common in the project area except at higher elevations, preferring the rough, brushy country associated with pinon-juniper wood land. It tends to concentrate west of U.S. Highway 666 from Cortez to Dove Creek and north of Dove Creek but is also common in Mesa Verde National Park. There are approximately 500 gray foxes in the area.

The ringtail cat is rarely found in the area. It is known to inhabit hollow trees, cliffs, canyons, and abandoned mines and cabins in arid areas. Although suitable habitat exists in Cross, Yellow Jacket, and Dolores Canyons, the nearest observation was recorded in McElmo Canyon.

The badger tends to inhabit open grass land, parks, and crop land. Its range is scattered throughout the study area but occurs mostly west of the Dolores River from Pleasant View to the Utah State line. Smaller ranges exist in Mesa Verde National Park, north of Cortez, and in the San Juan National Forest, east of Dove Creek. Badgers number approximately 250, and their status is considered uncommon in the study area.

The kit fox may occur in the project area, having been previously reported in McElmo Canyon and southwestern Montezuma County. It is considered to be extremely rare, however.

(5) Varmints

The Colorado Division of Wildlife classifies varmints as mammals which offer favorable opportunities for sport harvest and which sometimes cause significant damage to public property or nuisance to human interest. Species inhabiting the project area include the coyote, raccoon, bobcat, porcupine, jackrabbit, rock squirrel, prairie dog, and marmot.

Coyotes are common throughout the project area, particularly at lower elevations. The coyote is almost entirely carnivorous and is normally active at night. Several concentrations are present in and near the project area, totaling an estimated 900 animals.

Raccoons are most common along streams, ponds, swamps, and irrigated areas. Although they tend to concentrate around Cortez and Mancos, they have also been reported along the lower Dolores River, McElmo Creek, and in the Dove Creek area. Populations are estimated at 500 within the study area.

Bobcats range throughout the study area, with the greatest densities in rough, brushy canyons and draws at lower elevations. They are common along the Dolores River downstream from the town of Dolores. The estimated population of bobcats in the study area is 600, found mostly in the southern and western portions of Montezuma County and the western portion of Dolores County.

Porcupines may be found throughout the study area, but they prefer forested areas and are common in ponderosa pine forests and dense stands of pinon-juniper wood lands. They are found throughout the McPhee Reservoir site, McElmo Canyon, and near Mesa Verde and Totten Reservoir.

Jackrabbits in the area include the black-tailed and possibly the white-tailed jackrabbit. The black-tailed jackrabbit is common at lower elevations, inhabiting grass lands, crop lands, and brush lands. The white-tailed jackrabbit is uncommon in the project area, tending to inhabit higher elevations. The population of jackrabbits in the area is estimated at 9,500.

Considered to be locally abundant, rock squirrels are particularly common in rocky areas or along brushy stream bottoms. In the study area, they are commonly found along the Dolores River below Dolores and in pinon-juniper wood lands.

The range of the Gunnison's prairie dog in the area covers the western half of the Ute Mountain Ute Indian Reservation and extends west of Mancos to the Utah State line and north of Cortez and Dolores. The animals locate their towns in open grass land, where they feed on grasses, sedges, and forbs. Active only during warmer months, their estimated population in the study area is 22,000, mostly around Cortez and on the reservation.

The yellow-bellied marmot is generally restricted to areas above 6,000 feet in elevation. Suitable habitat consists of rocky outcrops and talus slopes near mountain peaks, where green forage is available. Due to the elevation requirements, suitable habitat is found only in certain restricted parts of the project area. A population estimated at 500 animals inhabits portions of the upper Dolores River.

(6) Other Nongame Mammals

Nongame mammals in the project area include chipmunks, ground squirrels, pocket gophers, mice, rats, voles, shrews, and bats. These animals are important elements in the ecology of the project area. Over 50 nongame mammals were trapped by the Colorado Division of Wildlife during its inventory. Caught in the vicinity of the McPhee and Dawson Draw Reservoir sites were the deer mouse, Colorado chipmunk, least chipmunk, golden-mantled ground squirrel, and bushy-tailed woodrat.

(7) Gamebirds

Turkeys are found in ponderosa pine forests which support an understory of Gambel's oak and in pinon-juniper wood lands. Two small flocks of approximately 10 birds each are reported in areas east of Dolores, the remnants of a population reduced by disease in 1959.

The ring-necked pheasant is an introduced bird which ranges from the Cortez area to Pleasant View. Preferring farm lands as a habitat and requiring vegetative cover throughout the year, the pheasant populations are known to exist north and south of Cortez, around Totten Reservoir, and in McElmo Canyon. The Colorado Division of Wildlife estimates that 1,500 pheasants inhabit the study area.

The blue grouse, requiring a forest environment in the lower ponderosa pine belt or higher spruce-fir zone, is widely distributed throughout the higher elevations of the project area. Most of the range is north and northeast of Dolores and north of Mancos, with approximately 750 birds in the study area itself.

The sage grouse inhabits areas in the vicinity of Dove Creek and the Great Cut. It is considered to be uncommon in the study area since it is dependent upon a sagebrush environment which is not abundant. No strutting grounds were observed during the studies.

The sharp-tailed grouse inhabits a variety of vegetative types, particularly rougher oakbrush from 7,000 to 9,000 feet in elevation. It is present near Mancos, north of Dolores, and on the National Forest from Dove Creek to Rico. The population is estimated to number 200.

Gambel's quail, which is considered to be uncommon in the area, inhabits warm dry valleys of salt desert shrubs and pinon-juniper wood land. It is present in McElmo Canyon and between Cortez and Towaoc.

The chukar is believed to inhabit parts of McElmo and Yellow Jacket Canyons, preferring areas of broken rimrock and dry climate. The populations are subject to extreme fluctuations but are currently estimated at approximately 600 birds.

The mourning dove inhabits a large range in the study area, seasonally concentrating east of Cortez and from McElmo Creek to Dove Creek, where dry land farming occurs. Seasonal concentration areas are located along the Dolores River, around existing reservoirs, within project reservoir sites, and on all crop lands.

The band-tailed pigeon is a common summer resident of coniferous forests but may also frequent pinon-juniper communities. There are two areas of concentration in the study area: one above Mancos and Dolores, the other west of Cortez and on the Ute Mountain Ute Reservation. Varying from year to year according to food supplies, the pigeon population is currently estimated at 1,500.

(8) Waterfowl and Shorebirds

Waterfowl and shorebirds found in the project area include ducks, geese, loons, grebes, herons, and gulls. The greatest concentrations of waterfowl are on Denny Lake, Totten Reservoir, and Narraguinnep Reservoir, although the use of other reservoirs and small ponds is common. Lack of water and feeding areas is a factor that limits waterfowl and shorebird populations in the project area.

Most species migrate south in the fall to New Mexico, Arizona, and Mexico. A few birds of certain species remain year-round, although most of their population migrates south in the winter. These winter residents include the Canada goose, mallard, gadwall, shoveler, American widgeon, teal, coot, and Franklin's gull. All of the waterfowl and shorebirds are considered common except for the common loon, great blue heron, and black-crowned night heron. Efforts are being made by the Colorado Division of Wildlife to establish a resident goose population.

(9) Raptors

The raptors, or birds of prey, that occur in the project area are eagles, hawks, owls, falcons, osprey, and vultures. The area contains a variety of good habitats for raptors, and areas for resting, hunting, and nesting are enhanced by relative isolation. Concentration and nesting areas have been identified north of Towaoc, east of Cortez, north and east of Dolores, north of Dove Creek, along the Dolores River, and around Narraguinnep and Totten Reservoirs. The birds are attracted to ponds, reservoirs, marshes, and rivers where waterfowl and other prey are present.

Common raptors using the project area include the turkey vulture, red-tailed hawk, rough-legged hawk, Cooper's hawk, kestrel, marsh hawk, Swainson's hawk, great horned owl, northern bald eagle, and golden eagle. Golden eagles and other cliff-nesting raptors may be found along the Dolores Canyon where suitable habitat exists.

(10) Nongame Birds

Nongame birds in the Dolores Project area include passerines, woodpeckers, rock doves, nighthawks, swifts, and hummingbirds. Many of these birds are migrants, nesting in the project area in the summer months. The Dolores River, along with its associated vegetative communities, provides significant habitat for a large number of species. Although several habitats support a variety of birds, the riparian wood land along the Dolores River and other waterways, which is probably the most limited in extent, is utilized by the greatest diversity of species. Next to the riparian community, nongame birds prefer crop land and pinon-juniper wood land.

(11) Reptiles and Amphibians

All of the amphibians and reptiles found within the project area are widespread in the southwestern United States. The most common species observed in the project area include the Great Basin sagebrush lizard, northern side-blotched lizard, and Utah tiger salamander. Species considered to be uncommon include the western leopard frog, two-lined skink, and desert striped whipsnake.

c. Threatened or Endangered Species

Studies by the Colorado Division of Wildlife and the Fish and Wildlife Service have revealed no threatened or endangered species of fish in the project area. An additional study funded by the Fish and Wildlife Service to determine the presence of endangered fish species in the San Juan River was recently completed, and no endangered species were discovered.

Although the Colorado Division of Wildlife reported no recent sightings of endangered wildlife species, historical sightings indicate the future possibility of the peregrine falcon in the Dolores River Canyon between the Bradfield Ranch, located approximately 10 miles below McPhee Dam site, and Slick Rock. This area contains excellent nesting habitat.

In a survey of the Ute Mountain Ute Indian Reservation, the Fish and Wildlife Service found signs of the possible presence of the endangered southern bald eagle and black-footed ferret. In compliance with Section 7 of the Endangered Species Act of 1973, the Bureau of Reclamation consulted with the Fish and Wildlife Service and completed studies to determine the status of these species on project lands.

Extensive potential habitat for the black-footed ferret exists on Ute Mountain Ute Indian lands southwest of the town of Towaoc, where essentially all of the proposed 7,500 acres to be irrigated are occupied by Gunnison's prairie dogs. The ferret preys on the prairie dogs and inhabits their tunnels. An August 1976 survey was conducted on approximately 2,600 acres of the project land, producing no evidence of ferrets. The large number of prairie dogs and relative remoteness of the area, however, do present the possibility that the black-footed ferret may exist there.[1]

The Fish and Wildlife Service report of possible nesting activity of the southern bald eagle on Ute Mountain Ute Indian land was investigated by aerial surveys in July 1976. Although no evidence was found to substantiate the report, the surveys did locate a pair of mature peregrine falcons southwest of Cortez and east of the town of Towaoc. Excellent nesting sites were found in the vicinity, but it is not known whether the birds had attempted to nest during the 1976 season.

The grizzly bear is designated as threatened on the Federal list of threatened and endangered species and endangered on the Colorado list. Although project land is within the historical range of this species no evidence of its presence was reported by the Colorado Division of Wildlife or the Fish and Wildlife Service.

The gray wolf, wolverine, river otter, and Canada lynx are also recorded as endangered by the State. The Canada lynx and wolverine inhabit spruce-fir communities similar to that at the headwaters of the Dolores River above the project area. No evidence of these species has been reported in recent studies. The river otter and gray wolf have historical ranges which occur in the project area, yet studies have not revealed their presence.

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[1] U.S. Fish and Wildlife Service, State Supervisor, Animal Damage Control. Letter to the Bureau of Reclamation, Denver, Colo., August 10, 1976.

d. Vectors and Related Problems

The U.S. Public Health Service reported on vectors and related problems of the area in 1961 and 1975.[1/] Several species of mosquito are common, particularly in marshy seeps along natural drainageways, farm ponds, floodwater pools along the Dolores River, marshy areas south of Cortez, and other areas that collect water. The species *Culex tarsalis* is a vector for encephalitis, a brain disease of horses and humans and probably the most important vector-borne disease in the project area. Data indicate that this disease has been active in the past and may break out in the future. The *Anopheles freeborni* is the western vector of malaria and is also common, but the parasite for the disease does not survive the winter in the local climate. Several species of *Aedes* mosquitoes prevalent in the area are severe biters and may cause health problems for individuals, particularly children, because of secondary infections and allergic reactions. Other mosquitoes, although not posing health problems, may interfere with human activities in local areas.

The Rocky Mountain wood tick, which is common in the area, can transmit Rocky Mountain spotted fever and Colorado tick fever to humans. The tick may also transmit tularemia, but the disease is very uncommon at the present time.

Bubonic plague, like tularemia, is a disease principally of rodents but also capable of affecting humans. In southwestern Colorado, plague organisms have been identified numerous times in fleas from wild animals.

9. Historical and Archaeological Sites

a. Historical

The project area contains a site of regional historic interest, the Dominguez-Escalante Trail of 1776. The trail marks a historic 1,800-mile trip by two Franciscan padres, Fray Francisco Antanasio Dominguez and Fray Silvestre Valez de Escalante, from Sante Fe, N. Mex., northward through western Colorado, across northern Utah, southward through western Utah, and across Arizona back to Sante Fe. This route took them through the Dolores Project area (see Figure B-7). The expedition was intended to discover an overland route between the Spanish missions in Santa Fe

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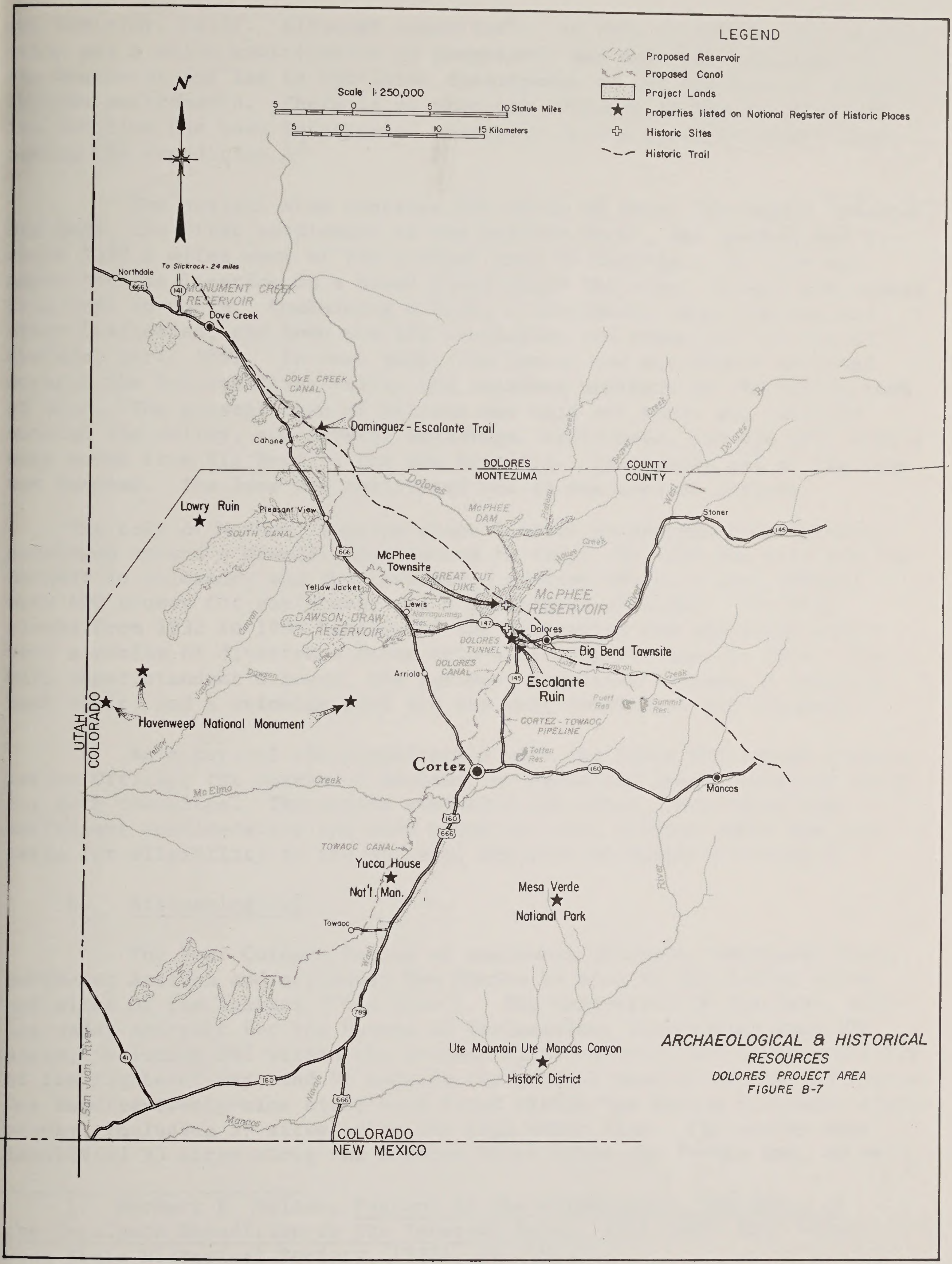
[1/] U.S. Public Health Service, Department of Health, Education, and Welfare, *Report on the Public Health Aspects of the Dolores Project, Colorado* (November 1961) and letter of April 14, 1975, to the Bureau of Reclamation.



ARCHAEOLOGICAL & HISTORICAL RESOURCES
DOLORES PROJECT AREA
FIGURE B-7

and Monterey, Calif. Although unsuccessful in this objective, the exploration was a major contribution to geographic and cultural knowledge of the Southwest and led to the later development of the old Spanish trails between settlements. There is no physical evidence of the trail itself. Its location has been interpreted primarily from a diary Escalante kept during the expedition.[1]

The project area contains two sites of local historical interest. Big Bend, the first settlement on the Dolores River, was established in about 1880 2 miles west of the present town of Dolores. The town was named for its location on a broad plain where the river changes its course from west to north. Containing a bank, a blacksmith shop, stores, and other businesses, the town was the population and commercial center of the area until 1891. In that year, the Denver and Rio Grande Railroad entered the Dolores River valley and extended upstream to the mining town of Rico. The present town of Dolores was laid out where the railroad entered the valley, and several buildings, businesses, and the post office were moved from Big Bend to the new townsite. Eventually all of the town was removed. The land was cultivated and is now used as pasture.

The town of McPhee, located about 5 miles downstream from Dolores, developed around a sawmill constructed in 1924. By 1929 the mill was the largest in Colorado, and the town had a company store, a post office, over 100 houses for employees, and a population of 1,500. The mill closed from 1932 to 1934 because of the depression and afterward underwent a series of disastrous fires before closing for good in 1948. The mill superintendent's house, the resident physician's house, a concrete bank vault, and a swimming pool are the only remains at the townsite.

As a part of the consultation with the State Historical Preservation Officer, the Bureau of Reclamation submitted State Inventory Forms for both townsites. The office evaluated the sites, concluding that sufficient consideration had been given and that neither meets the criteria for eligibility to the National Register of Historic Places.[2]

b. Archaeological

The Four Corners Region of southwest Colorado, southeast Utah, northeast Arizona and northwest New Mexico is rich in the Indian ruins and sites of the Anasazi ("Old Ones"). The University of Colorado, working under contract for the Bureau of Reclamation, inventoried over 550 sites, including 282 within the project rights-of-way, 179 in the vicinity of the rights-of-way, and 91 outside the general area of project influence. One hundred-twenty-nine sites were found within the McPhee Reservoir right-of-way, including 57 sites below the high water line. The survey also identified 33 sites along the Dolores River below the McPhee Dam, 40 at

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[1] Herbert E. Bolton, Pageant in the Wilderness: The Story of the Escalante Expedition to the Interior Basin, 1776 (Salt Lake City: Utah State Historical Society, 1972), pp. 29-33.

[2] Correspondence from the State Historical Society of Colorado to the Bureau of Reclamation dated July 7, October 7, and November 21, 1975.

Great Cut Dike and along the Dove Creek and South Canals, 38 along the Dove Creek area laterals, and 42 along the Towaoc Canal and laterals. The sites vary in extent, with surface indications including rock chips, pottery, pithouses, and remains of pueblos and other structures. The archaeological sites represent past occupation of the area from perhaps 2500 B.C. until historic times. Relatively little work has been previously done, and information on the prehistoric habitation is consequently meager. The sites are classified according to cultural periods ranging from about 2500 B.C. to A.D. 1350. (see Table B-6). In addition, six sites presumed to be of historical age were found, consisting primarily of Ute or Navajo Indian sweat lodges. Attachment 2 contains a list of the sites according to project feature, cultural period, predicted impact, and recommended mitigation measures. Six properties containing Anasazi ruins are listed on the National Register of Historic Places.[1] Their locations in relation to project features are shown on Figure B-7.

Table B-6
Archaeological and historic periods and characteristics
Dolores Project area

Cultural period	Characteristics
(2500 B.C. - A.D. 1)	Evidence that man was hunting and perhaps living year-round in the McPhee area by at least 2500 B.C. Tools and other artifacts predominantly of stone. None of these early sites has been excavated.
Basketmaker II (1 - A.D. 500)	Tools and other artifacts of stone, baskets, seminomadic hunters. Agriculture begins late in the period.
Basketmaker III (500 - A.D. 750)	Baskets, fired pottery, farming, small villages of pit-houses with nearby storage facilities.
Pueblo I (750 - A.D. 950)	Continuation of large pithouses, beginning of surface habitations, red ware pottery, textural manipulation in cooking pots.
Pueblo II (900 or 950 - A.D. 1150 or 1200)	Masonry surface villages, new styles of pottery, supplementary features such as sewers and irrigation check dams.
Pueblo III (1150 or 1200 - A.D. 1300 or 1350)	New styles of pottery, larger pueblos, climax of the Anasazi culture.
Historic Sites	Evidence of occupation by Ute and Navajo Indians and homesteaders. The sites are primarily sweat lodges and lithic scatter.

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[1] Federal Register, Vol. 41, No. 28 (February 10, 1976).

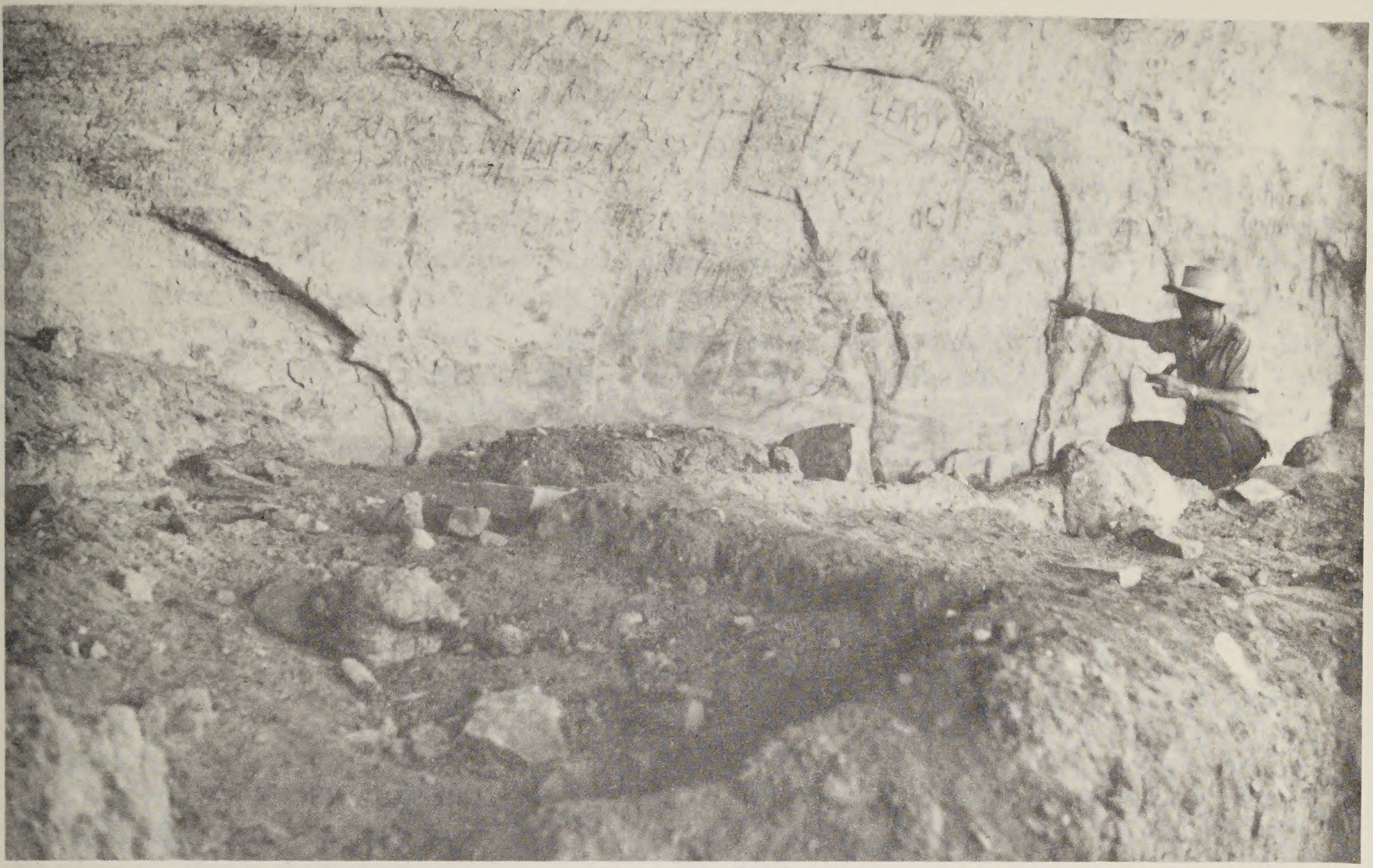

Figure B-8--Basketmaker III site within a small alcove. Remnants of at least two pithouses are evident.

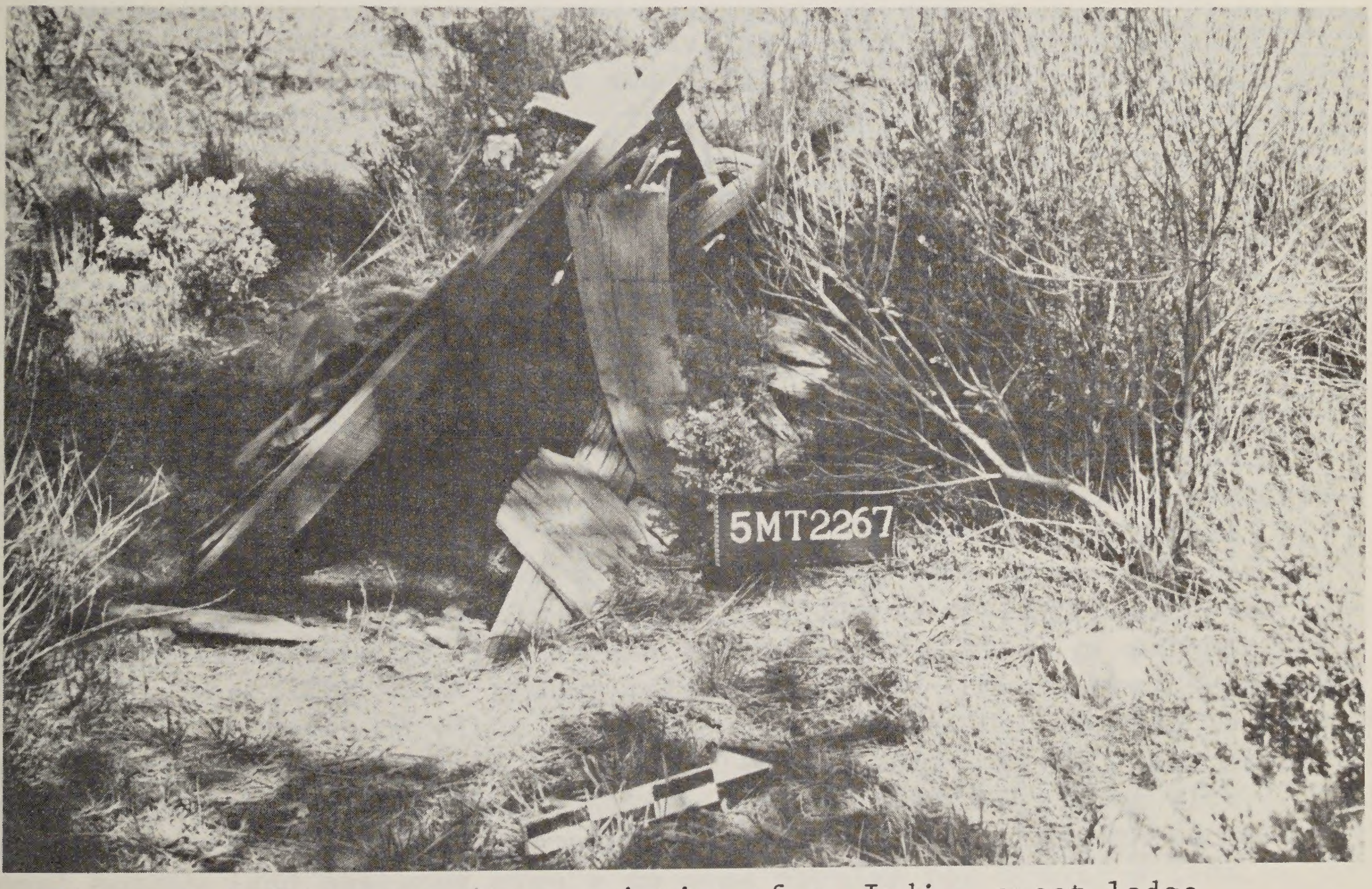

Figure B-9--Historic site consisting of an Indian sweat lodge constructed of planks (probably rough pine).

10. Land Ownership

Montezuma and Dolores Counties contain just over 2,000,000 acres, as shown in Table B-7, consisting of 1,074,900 acres of private land (including the Indian Reservation) and 925,600 acres of public land. Most of the National Park Service land lies within Mesa Verde National Park, with smaller amounts in Yucca House and Hovenweep National Monuments. The 605,000 acres of Forest Service land comprise about one third of the total San Juan National Forest in southwestern Colorado, with the bulk of the forest lying to the east. State and local governments, which own less than one percent of the total area, have leased most of their land to farmers and ranchers. The Ute Mountain Ute Indian Reservation, in addition to its 433,000 acres in Montezuma County, contains 107,500 acres in New Mexico and 13,500 acres in Utah.

Table B-7
Land ownership

	Montezuma County	Dolores County	Total
Private	375,700	266,200	641,900
Indian	433,000		433,000
Bureau of Land Management	209,300	42,200	251,500
Forest Service	260,200	345,400	605,600
National Park Service	51,800		51,800
State and local governments	11,900	4,800	16,700
Total	1,341,900	658,600	2,000,500

The proposed project rights-of-way, as stated in Chapter A, contain 12,437 acres of private land and 6,222 acres of public land (nearly all located at McPhee Reservoir). The public land has been withdrawn by the Bureau of Reclamation, which essentially prohibits uses not consistent with project purposes. Figure A-18 shows the distribution of land ownership at the site of the McPhee Reservoir.

11. Scenery

The project area is located in a basically rural setting, marked by clear air, generally unobstructed views, and a wide variety of scenery. In the broad, undulating terrain of the Dove Creek area, isolated patches of native vegetation break the formal patterns of the extensive farm lands, contrasting with the red soil and the long rows of crops. The scattered farmsteads, generally located in clusters of trees, also provide occasional breaks in the terrain and add to the sense of perspective. To the southwest, the broad ridges gradually narrow into fingers separated by deeply cut canyons of pinon and juniper, the farm land running in small strips along the top. To the north the land rises gradually, then drops abruptly into the Dolores River Canyon, where the wooded slopes with occasional rock outcrops, the dense riparian vegetation, and the occasional bottom land pastures create an area popular for scenic drives.

Montezuma Valley is also an agricultural area, characterized by pastures, livestock, brush fence rows, occasional orchards, and farmsteads.

The valley gradually narrows toward the south, closed in by the pinon- and juniper-covered slopes of Sleeping Ute Mountain on the southwest and the long escarpment of Mesa Verde on the southeast. When viewed from an area east of Cortez, the mountain forms the profile of a man lying on his back with arms crossed, a resemblance which has given it a place in the legends of the Ute Mountain Ute Indians.

To the south of Montezuma Valley, forms typical of the southwestern desert dominate the landscape. Austere and intensely eroded, the area is marked by contrasting lines. The horizontal impressions of flat-topped mesas, terraces, plains, valley floors, and exposed rock strata are strongly set off by the vertical emphasis of cliffs, rock chimneys, and deep canyons. The dry climate and imposing terrain have effectively limited development in such areas, and much of the land remains unaffected by man.

12. Economic and Social Conditions

a. Population

The U.S. Bureau of the Census reported a 1970 population of 12,952 for Montezuma County and 1,641 for Dolores County. The populations of the major communities were 6,032 for Cortez, 1,107 for Towaoc, 820 for Dolores, and 619 for Dove Creek. The rural population is distributed primarily in the vicinity of Cortez and along U.S. Highway 160 between Cortez and Dove Creek.

The population is composed primarily of Caucasians (including 1,473 Spanish-Americans in Montezuma County) and Indians. The Indian population is largely concentrated on or near the Ute Mountain Ute Indian Reservation. A breakdown of the census is shown in Table B-8.

Table B-8
1970 population by race[1/]

	Montezuma County	Dolores County
Caucasian	11,828	1,473
Indian	1,054	155
Blacks	14	
Other	56	13
Total	12,952	1,641

1/ 1970 U.S. Census.

The growth of the two counties from 1930 to 1975 is shown in Table B-9. A large increase from 1950 to 1960 resulted primarily from a boom in oil and uranium exploration, which brought about a substantial immigration. This activity dropped sharply between 1960 and 1970, producing a general decline in the total population, and the town of Dolores was the only community in the area that continued to grow during this period. Much of the general decline occurred among the youth of the area because of a high degree of independence among high

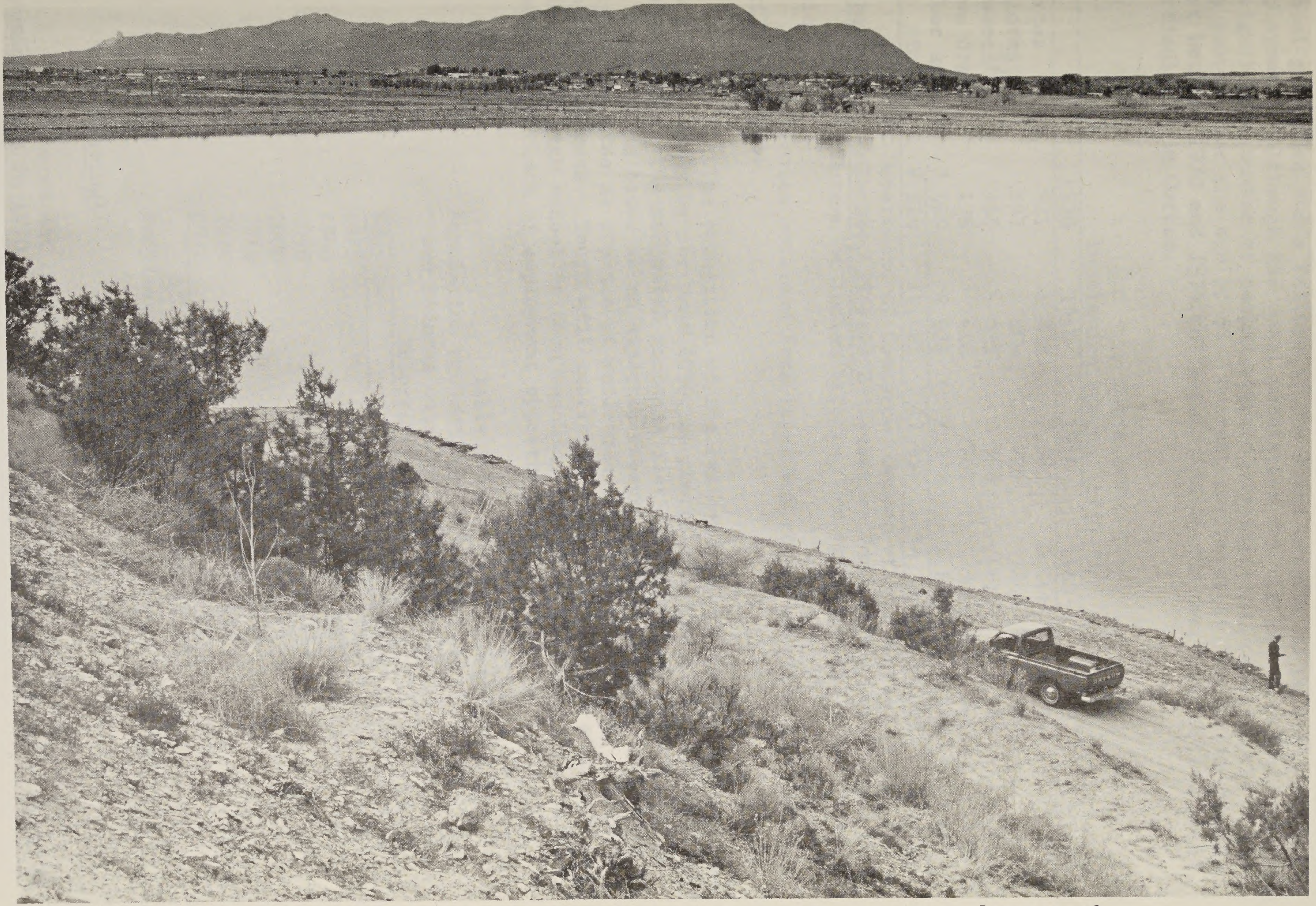

Figure B-10--Sleeping Ute Mountain with Totten Reservoir in foreground.

school graduates and a failure of the local economy to provide adequate employment. Although the total population for the two counties decreased, a significant number of people migrated to the area, particularly involving people over the age of 60. Current estimates of population indicate that between 1970 and 1975 the population of the two counties increased, particularly in Cortez.

Table B-9
Population growth, 1930-75[1/]

	1930	1940	1950	1960	1970	1975[3/]
Cortez	921	1,778	2,680	6,764	6,032	7,278
Dolores	557	804	729	805	820	970
Towaoc[2/]	485	493	568	813	1,107	1,301
Dove Creek	178	418	702	986	619	625
Other areas	7,069	8,928	7,278	6,852	6,015	6,601
Total	9,210	12,421	11,957	16,220	14,593	16,775

1/ U.S. Department of Commerce, Bureau of the Census, Number of Inhabitants, Colorado, 1939-1970, Census of Population, Washington, D.C.

2/ U.S. Bureau of Indian Affairs, Ute Mountain Ute Tribe, Towaoc, Colo.

3/ Estimates obtained from local and county government, based on utility hookups.

The population of the two counties is expected to increase by 20,700 people by the year 2030, an annual increase of 1.5 percent (see Table B-10). The projected increase over the historical annual rate of 1.3 percent is based on an expected expansion of tourism, the desirability of the area as a place of retirement, and the development of nearby energy resources. Youth will continue to migrate from the area upon completion of high school or upon reaching an age of 16 years and older because of the lack of employment opportunities.

Table B-10
Population projections for Montezuma and Dolores Counties without the Dolores Project[1/]

Year	Population
1975	16,775
1980	17,480
1990	22,400
2000	26,100
2010	29,570
2020	32,280
2030	37,460

1/ Estimated by the Bureau of Reclamation.

b. Housing[1/]

Dolores and Montezuma Counties contained 5,046 year-round housing units in 1970, including 4,335 single-unit structures. About 65

1/ Colorado Division of Housing, Colorado Housing: Current Inventory and Needs, Vol. II (Denver: January 1, 1972).

percent of the units were occupied by owners, 24 percent were occupied by renters, and 11 percent were vacant. There were 758 vacancies, of which 581 were year-round and 177 were seasonal or migratory. About 42 percent of the year-round vacancies were for sale or rent. About 12 percent of all of the housing units lacked all or some plumbing facilities. In 632 units, more than one person occupied each room.

The housing inventory has grown very slowly in recent years. The total increase in units was 425, consisting of 348 mobile houses brought into the area, 45 single-family units, and 32 units in apartment complexes.

Between 1975 and 2030, if the project were not built, approximately 20,700 additional people would require housing. With a two-county average of 3.2 persons per family, 6,500 new housing units would be needed. Although the existing vacancies in the area may at first meet part of this demand, a large number of vacant units should be replaced by 2030. The Colorado Division of Housing has estimated a total replacement requirement of nearly 410 units between 1970 and 1975.1/

c. Employment and Incomes

As part of the Four Corners Economic Development Region, which is characterized by depressed personal incomes and a persistently high rate of unemployment, the entire project area is eligible for public assistance under the Public Works and Development Act of 1965. According to the U.S. Department of Labor, unemployment in Montezuma and Dolores Counties was 5.9 percent in 1974, somewhat higher than the State average of 3.8 percent and the National average of 5.6 percent. The problem is particularly severe among the Ute Mountain Ute Indians, where the 1973 rate of employment was 38.4 percent and the 1975 rate of unemployment was 62.1 percent of the Indian labor force. Although comprising only about 7 percent of the population in the counties, the Indians account for 50 percent of the total unemployment. About 13 percent of the Spanish-American labor force was unemployed in 1974.2/

Per capita incomes in the area averaged only $3,904 in 1974, well below the State and National averages of $5,514 and $5,449, respectively. The most limited incomes occurred in rural areas, particularly within the Indian and Spanish-speaking populations. The average per capita income of Indians living on the reservation amounted to $2,125 in 1974, including a payment of $1,000 from the tribal fund to each member of the tribe. The average per capita income for Spanish-Americans was $1,693 in 1970.3/

The 1970 census reported that 14.2 percent of all the families in the area had incomes below the poverty level, a depressed condition when compared to the State figure of 9.1 percent and the National figure of 12.2 percent. More than 40 percent of the Indian population presently lives at or below the poverty level.3/

1/ Colorado Division of Housing.

2/ Colorado Division of Employment and Bureau of Indian Affairs.

3/ 1970 U.S. Census and Bureau of Indian Affairs.

d. Welfare

Welfare participation, including use of food stamps, decreased approximately 14 percent in Dolores and Montezuma Counties from 1971 through 1975. The part of the population receiving public assistance of some kind decreased from 9.2 percent in 1971 to 7.9 percent in 1975. During this same period, however, nonwelfare food stamp participants increased by 51.7 percent, from 5.8 to 8.8 percent of the total population. Comparable State data are not available.

e. Industrial Resource Base

(1) Retail and Wholesale Trade[1]

Retail trade, with approximately 950 employees in 1970, is the largest employer in the area, occupying about 21 percent of the the total work force. Total sales increased from $40.7 million in 1972 to $57.1 million in 1975. Although part of the increase was caused by inflation, most was attributed to an increase in sales volume. Trade has tended toward increasing centralization in the city of Cortez, and retail employment in Dolores County has declined dramatically since 1967. In terms of dollar value, the largest sales occur in the automotive and food sectors, followed by general merchandise and public utilities.

Wholesale trade employed 139 persons in 1970 or approximately 3 percent of the work force. Wholesale sales increased from $4.3 million in 1972 to $7.0 million in 1975.

(2) Government

The government, including public education, is the second largest employer in the area, with permanent employment of about 770 persons in 1970. Additional basic employment occurs during the summer as a result of the influx of tourists. The largest seasonal employment occurs at Mesa Verde National Park which added 120 temporary employees in 1975, with smaller increases in the U.S. Forest Service and county and municipal governments.

(a) General Conditions

Irrigated agriculture and dry farming rank third in employment in the project area, totaling approximately 500 employees (approximately 11 percent of the work force). The inclusion of related retail and wholesale business would increase this figure. Direct employment in agriculture is beginning to decline slightly as increased technology allows farmers to increase their farm size and to reduce the number of laborers required.

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[1] Colorado County and City Retail Sales by Stand Industrial Classification, Business Research Division, Graduate School of Business Administration, University of Colorado, Boulder, Colo.

The value of crop production increased from approximately \$5,697,000 in 1970 to \$12,244,000 in 1974.[1] Livestock and livestock products, particularly cattle, are becoming increasingly more important in the agricultural economy of the area. The number of cattle increased from about 35,000 in 1969 to 46,000 in 1974. In contrast, the number of sheep has remained relatively constant at 37,000, and poultry and hogs have declined consistently in numbers during the past 25 years.[2]

About 37,500 acres in the Montezuma Valley area are presently developed for irrigated agriculture, and the water supply is obtained from the Dolores River under the administration of the Montezuma Valley Irrigation Company. Water is distributed by an extensive canal and lateral system. The major enterprise is beef cattle, and the major crops raised for livestock feed are alfalfa, wheat and other small grains, pasture, and corn for silage. Commercial fruits and vegetables are also grown, but are of minor economic importance.

The project area contains about 62,000 acres that are dry farmed for pinto beans and wheat. The town of Dove Creek, in fact, calls itself the "Pinto Bean Capital of the World." Very small amounts of hay and grains other than wheat are also produced in the area.

The Towaoc area on the Ute Mountain Ute Indian Reservation has approximately 100 acres under cultivation. Little water has been available for irrigation, and precipitation is insufficient for successful dry farming.

(b) Agricultural Chemicals[3]

Weed control is limited to irrigated and dry-farmed grain fields, areas along irrigation ditches and canals, and patches of bindweed and canadian thistle in dry-farmed areas. Although use of herbicides to control mustard weed in grain and broad-leafed weeds in corn has been increasing, the only significantly used herbicide is 2,4-D in small grains, which amounted to about 295 pounds on approximately 1,179 acres. This herbicide is not persistent and is of low toxicity to animals. Atrazine and tordon, which can also be used for weed control, are persistent in the soil, although of low toxicity to animals. Banvel-D is not persistent and is of low toxicity to animals.

The need to control insects is directly related to the principal crops grown in the project area and the insects that infest them. Alfalfa, representing approximately 52 percent of the irrigated cropland, is the largest requiring a significant amount of pesticides, with 5,000 pints of Furadon and 2,500 pounds of Parathion used for weevil control on approximately 5,000 acres of alfalfa. Parathion, highly toxic to animals and persistent for only 3 to 5 days, is usually applied by ground equipment, although aerial application is used on a limited basis. Approximately 107 acres of orchards have been treated with 160 pounds of Guthion and 214 pounds of Diazinon. No measurable pesticides are used in the dry farming area.

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[1] Colorado Department of Agriculture, Cooperating with the USDA Statistical Reporting Service, Colorado Agricultural Statistics, 1970-1975, Denver, Colo.

[2] U.S. Dept. of Commerce, Census of Agriculture, Colo., 1949, 1959, 1964, 1969, and 1974, Washington, D.C.

[3] Estimates of chemicals taken from the 1971 farm management survey of the Dolores Project area and the U.S. Department of Commerce, 1969 Census of Agriculture, (Washington, D.C.)

Present annual use of chemical fertilizers amounts to approximately 814 tons of phosphate and 344 tons of nitrogen. Alfalfa accounts for all of the 814 tons of phosphate, while small grains, corn silage, and rotation pasture utilize nitrogen at the rate of 121 tons, 97 tons, and 126 tons, respectively. The exact number of acres fertilized is unavailable, but the 26,300 acres of irrigated land includes 13,676 acres of alfalfa, 5,260 acres of small grains, 789 acres of corn silage, and 3,945 acres of rotation pasture.

Laws banning the use of certain pesticides and herbicides have encouraged the use of those which are less residual but still somewhat toxic. It is anticipated that this trend will continue. The use of commercial fertilizers will also increase, but not significantly.

(4) Recreation and Tourism

Recreation and tourism are an important part of the economic base of the area, which contains such recreational attractions as mountains, streams, reservoirs, and archaeological sites. Among the popular recreation activities are picnicking, sightseeing, backpacking, camping, hiking, horseback riding, boating, hunting, and fishing. Over half of the participants reside outside the area.

A major factor in the many opportunities for outdoor recreation is the large amount of public land in the area. About 46 percent of the 2 million acres in Dolores and Montezuma Counties is publicly owned as the following table shows.

Table B-11

Land ownership Dolores and Montezuma Counties

	Percent of area
Private	32
Ute Mountain Ute Indians	22
State and local government	Negligible
Forest Service	30
Bureau of Land Management	13
National Park Service	3
Total	100

The San Juan National Forest, offering a mountainous environment with high peaks and extensive forest, received approximately 1,701,000 visitor-days of use within the two counties in 1975. The Forest Service has constructed six campgrounds in the counties, with a total of

100 units and two picnic grounds with 7 units. A small ski area is operated by a Forest Service concessionaire at Stoner northeast of Dolores and is used primarily on weekends by local residents.

Mesa Verde National Park contains well preserved prehistoric cliff dwellings, protected wildlife, and undisturbed vegetation. Annual visitor use is about 600,000 days and reached 615,000 in 1975. The Ute Mountain Ute Indian Tribe is developing a Tribal park that will feature a large number of Indian ruins similar to those at Mesa Verde. Adjoining the National Park on the south, the development will include campgrounds, a visitor center, trails, and other facilities.

Most of the tourists spend money at service stations, hotels and motels, restaurants, curio shops, and grocery stores. Studies by the State of Colorado and the Denver Research Institute at the University of Denver indicate that the average visitor to the State spent $10 daily in 1968 and $16 daily in 1975. The figures indicate that visitors to Mesa Verde National Park and the National Forest could have spent as much as $37,056,000 in 1975.

The Bureau of Land Management (BLM) administers over 250,000 acres of land within the two counties. Although there are no developed areas, the land provides opportunities for hunting, fishing, hiking, and sightseeing. Lowry Ruin, a National Historical Landmark managed by the BLM, receives over 2,000 visitors annually.

Hunting use in game management units 71, 72, and 73 is estimated at 97,680 man-days for 1975.1/ Fall hunting for deer and elk was about 52,600 man-days, with a large portion due to nonresidents. Small game and waterfowl hunting was limited primarily to residents and amounted to about 12,000 man-days. Other hunting use was 4,170 man-days for bear, 22,190 man-days for varmints, and 6,720 man-days for game birds other than waterfowl. Fisherman use in the counties was estimated at about 142,300 man-days in 1975.2/

Rafting and kayaking are becoming popular on the Dolores River, particularly on the stretch from about 10 miles below McPhee Dam to Bedrock. In about 7 out of every 10 years, the runoff is sufficient for white-water boating during the spring but drops too low after the beginning of July. Because of high fluctuations in daily flows and the lack of predictability for good flows, only about 20 to 25 percent of the boating opportunities are used, resulting in an estimated 800 boating days of use annually. The annual use is expected to increase to about 1,200 boating days within the next 50 years.

During the summer months, employment is significantly above that of winter. Because of the influx of summer tourists, large numbers of employees, usually students, are added to the work force. The seasonal nature of tourism and other major occupations, however,

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1/ Soil Conservation Service, U.S. Department of Agriculture, An Appraisal of Outdoor Recreation Potentials in Dolores and Montezuma Counties (May 1970).

2/ Colorado Division of Wildlife Annual Surveys - 1975 causes problems of unemployment and underemployment during the winter months. The Cortez Chamber of Commerce estimates that during the winter employment is down by as much as 50 percent.

(5) Manufacturing[1]

In 1970 manufacturing employed 340 people, or about 8 percent of the work force. The value of manufactured goods in the two counties decreased from $4.1 million in 1972 to $2.5 million in 1975. The most important manufacturing enterprises have been in wood products, including sawmills, and a match factory in Mancos. Dry ice production and several small food processing operations such as a flour mill, a packing plant, and a dairy are also located in the area. The only manufacturing on the reservation is a pottery plant operated by the Indians near Towaoc.

(6) Mining

The mining industry has declined recently in Montezuma County but has increased in Dolores County since 1970, with lead and zinc being the most important products.[2] The eastern half of Dolores County has relied particularly on the mining industry, thereby experiencing the fluctuations connected with a purely mining economy. Mineral production has been far less important in Montezuma County, having a very minor influence until the mid-1950's, when the discovery of oil and natural gas fields and the beginning of a sutstantial sand and gravel operation caused increased activity. The finding of oil led to extensive exploration and wildcatting, with production reaching a peak in 1965. Production decreased substantially by 1970, and exploration for new oil and gas reserves has almost stopped. Approximately 300 people, or 7 percent of the work force in the two counties, were engaged in mining in 1970.

f. Facilities and Services

(1) Education

The two counties have a total of 20 schools in operation, including 3 senior high schools (in Mancos, Cortez, and Dove Creek), 12 elementary schools, and 3 junior high schools. A special education school is located in Cortez, a combined junior and senior high school is located in Dolores, and a technical college is located on Highway 160 between Mancos and Cortez. The nearest institution of higher education is Fort Lewis College in Durango. In 1972, the area had 4,410 students and 203 teachers.

Public schools located in Dolores County are operating at near capacity. Most of the structures are old and should be replaced or expanded for future growth. In Montezuma County the schools are newer and can sustain growth in the near future but should be expanded for long-term growth.

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[1] Graduate School of Business Administration, University of Colorado, Boulder, Colo.

[2] Colorado Division of Mines, Annual Summaries of Mineral Industry Activities, 1930-1974, Denver, Colo.

(2) Police and Fire Protection

The Colorado State Patrol covers Montezuma and Dolores Counties through an office in Cortez police protection is also provided by the Montezuma and Dolores County Sheriff's Departments, and by local forces in Cortez, Dove Creek, and Towaoc. Volunteer groups available in the event of emergencies include a search and rescue team in Dolores County and the Ute Mountain Citizen Band Club.

Fire stations are located in Cortez, Dove Creek, and Dolores and their services extend into the rural areas. The Ute Mountain Ute Indians maintain a small fire department, with a chief and two or three men, at Towaoc.

Police and fire protection in most of the communities should be expanded to keep up with future population growth. Existing fire departments cover large geographical areas but are able to meet emergencies through the cooperation of rural and urban departments.

(3) Water and Sewage

Cortez, Dove Creek, Mancos, and Dolores all have public water systems. Most homes in the rural areas, particularly in the dry-farm areas, have cisterns which they fill periodically by hauling water from the nearest public source. Rural homes must also provide their own disposal systems, such as some combination of a cesspool, holding tank, and drainage field.

To accommodate any future growth, additional water supplies must be developed for municipal and industrial use. The towns of Cortez, Dove Creek, and Towaoc and the rural areas could obtain future supplies by jointly providing storage on the Dolores River and diverting the stored water into the San Juan River Basin under a contract with the Montezuma Valley Irrigation Company. Additional treatment facilities, trunk lines, and distribution lines would be required.

(4) Transportation

The main roads in the area are U.S. Highways 160 and 666 and four Colorado State highways. The heaviest traffic occurs on U.S. Highway 160 south of Cortez in Montezuma County and on U.S. Highway 666 in Dolores County. County roads, most of which are gravelled, provide general access, and are generally under the Federal Aid Secondary System.

At the present time, Continental Trailways Bus Line provides regular but infrequent service to Dove Creek, Cahone, Cortez, Dolores, and Mancos. Service to cities outside the area goes in all

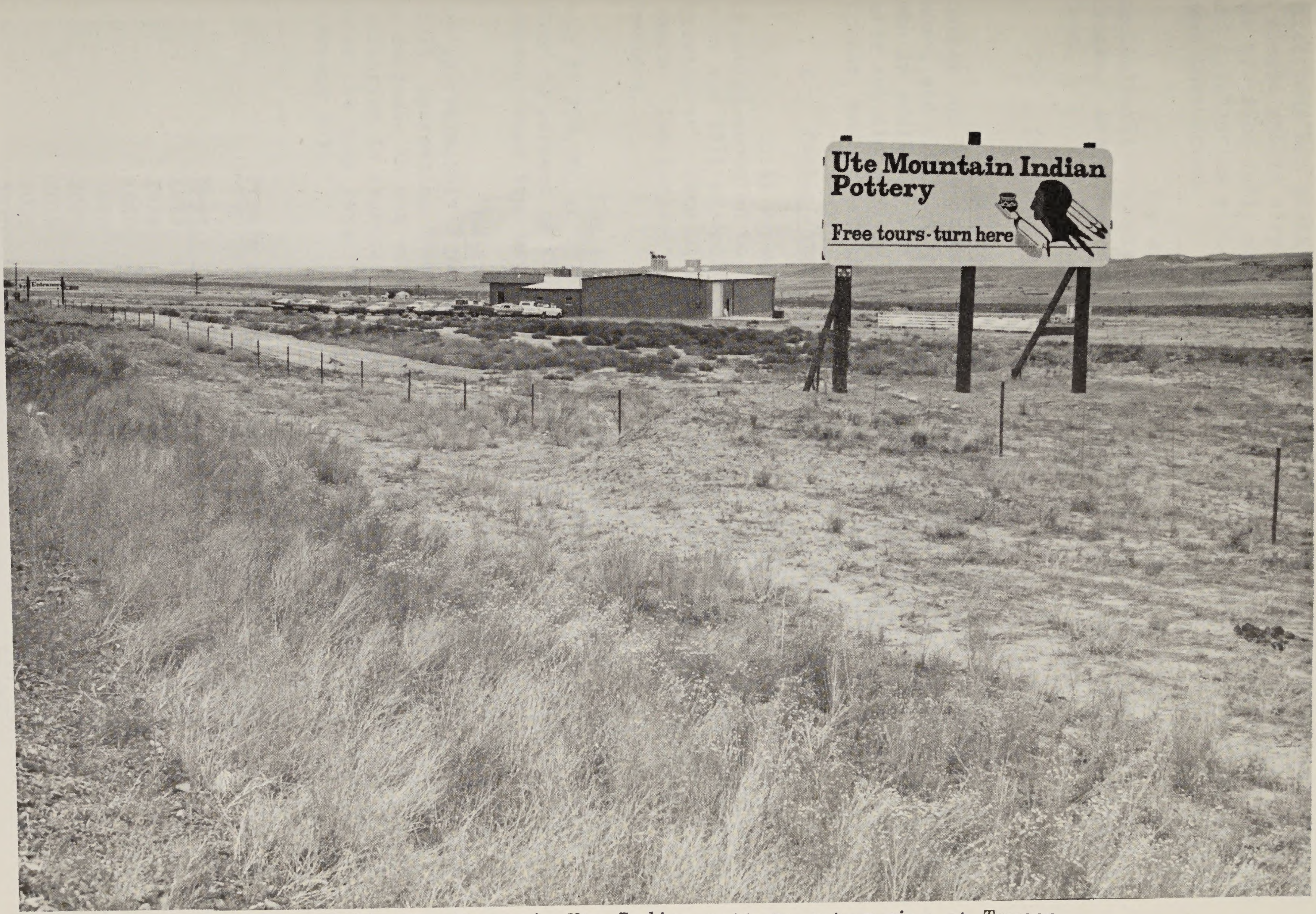

Figure B-11--Ute Mountain Ute Indian pottery enterprise at Towaoc.

directions but south. Both Dolores and Montezuma Counties are served by a single public airport, which is located just south of Cortez. West Air provides daily airline passenger service to major cities in Colorado and neighboring states. A private airport is located in Dolores County near Dove Creek.

The area has no railroad service. Livestock and other agricultural products which are shipped out of the area are hauled by trucks. Most livestock is shipped to the market terminal at La Junta, Colo.

(5) Health Facilities

Health facilities in the project area are located in Cortez and Dove Creek. Cortez has a 63-bed hospital, a 60-bed nursing home, and clinical facilities. Dove Creek has a clinic with a doctor who is available for services one day each week. Medical needs in the area are also met by a small medical clinic in Mancos, 15 miles east of Cortez, and by facilities in Durango, 45 miles east.

g. Public Finance and Tax Base

Total expenditures for the governments of Dolores and Montezuma counties amounted to about $3,491,800 in 1975, an increase of 53 percent over the 1971 expenditures of $2,282,400. The expenditures have been growing at a rate of more than 10 percent annually during the last 4 years. The largest annual expenditures are for highways and public welfare.

The two counties had total revenues of $2,301,400 in 1971 and $3,294,800 in 1975, for an annual increase of about 9 1/2 percent. Over 60 percent of the total revenue came from state funds, and 28 percent came from property taxes.1/

The assessed valuation of the area grew at an annual rate of approximately 3 percent during the 15-year period from 1960 through 1975, increasing from $26,668,000 to $41,354,000. There was, however, a decrease in assessed valuation for the years 1961 through 1964. The valuation is expected to continue growing at about 3 percent annually over the long term. Table B-12 summarizes the estimated valuations through 2030.

Table B-12
Future assessed valuation without the project

Year	Assessed valuation
1975	$42,490
1978	46,095
1980	48,900
1990	65,720
2000	88,320
2010	118,700
2020	159,520
2030	214,380

1/ State of Colorado, Department of Social Services, Denver, Colo.

h. Cultural Values

Montezuma and Dolores Counties have a wide range of cultural values. The population consists of the traditional farming population, Indians, Spanish-Americans, and a new groups of retired people who have moved into the area.

The Indians, even though they have adopted many elements of the cowboy culture, have in the past remained separate from the caucasian population of the area. Most of the Ute Mountain Utes prefer to maintain their cultural identity. They still hold ceremonies such as the Bear Dance and the Sun Dance, although these are becoming more of a tradition than a part of religious ritual. The isolation of the tribe, however, is beginning to cease. The children are bussed to schools in Cortez, and some of them leave the reservation in pursuit of employment, education, or for other reasons. Still, a large number of children are not leaving, and the reservation population at Towaoc is steadily increasing. Some of the Indians are gradually participating in the social and cultural activities of the caucasion population.

With the constant influx of retired people, as well as those moving in for other reasons, a gradual changing of the cultural values of the area may be seen. More emphasis is being put on such activities as concerts, plays, and movies. In addition, the area is characterized by a very diversified religious background which helps to emphasize the cultural variety. Nearly all of the major Christian religions are represented, as well as many non-Christian religions.

Recreation is of equal importance to the natives and newcomers alike. The development of outdoor recreational resources is one area which brings the joint support of all social groups, regardless of their cultural background.

The gradual trend away from an agrarian society and toward urbanization should continue without the project. The cultural values of the Ute Mountain Ute Indians may experience some changes. As an annual source of income, the tribe depends heavily upon the tribal fund, which receives revenues from tribal industries and energy resource leases. The fund has gradually declined, and the tribe thus needs a stabilizing source of income which could be provided by the development of 7,500 acres of agricultural lands under project conditions. Without the project, and faced with the decreasing tribal fund, many members may be forced to leave the reservation in search of employment. This emigration would tend to erode the cultural values which the Ute Mountain Utes are striving to retain.

CHAPTER C

ENVIRONMENTAL IMPACTS OF PROPOSED ACTIONS

C. ENVIRONMENTAL IMPACTS OF PROPOSED ACTION

1. Air Quality and Noise Levels

The project would not have long-term impacts on ambient air quality, but it would have some short-term effects during the 9-year construction period. Emissions and dust from construction equipment, blasting operations, and handling of earth or aggregate materials, and smoke from burning cleared timber and brush or rubbish would increase particulate levels in the atmosphere and decrease air quality locally during construction. Another nuisance would be noise generated by construction equipment and blasting.

2. Geology

Along the north shore of the upstream portion of McPhee Reservoir some very limited land slumping could occur. The water line in this portion of the reservoir would be in the soft Morrison Formation, and wave action resulting from prevailing southwesterly winds could erode into this formation causing minor movement of the Burro Canyon Formation from above. If slumping did occur, it would not be in a magnitude which would threaten the safety of the dam, but it would create land scars and, for short periods, increase the turbidity of reservoir water.

The potential for oil and gas production should not be significantly affected by construction, since all productive areas can be reached by drilling angle holes.1/ Sand and gravel deposits in McPhee Reservoir basin would no longer be available for commercial use. No other mineral resources of commercial value would be affected by the project.

3. Electrical Energy

The project would annually use an average of 17 million kilowatt-hours of electric power, with a maximum demand of 13,000 kilowatts during the irrigation season (April 15 - October 15). The power would be carried by existing Federal and private transmission lines from the Colorado River Storage Project System.

4. Water Resources

Project diversions would deplete the average annual runoff of the Dolores River by 105,200 acre-feet, or about 21 percent of the flow discharged into the Colorado River in southeastern Utah. This depletion

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1/ Bureau of Mines, Intermountain Field Operations Center, Denver, Colo., letter to Bureau of Reclamation, Durango, Colo. (July 14, 1975).

would be reflected in the Colorado River between the mouths of the Dolores and San Juan Rivers, a distance of about 240 river miles. In the San Juan River Basin, the annual return flows would average 25,000 acre-feet, but would be slightly offset by the evaporation of 700 acre-feet at Dawson Draw Reservoir. The resulting flow of 24,300 acre-feet would produce a net project depletion of 80,900 acre-feet in the Colorado River below the mouth of the San Juan, or about 1 percent of the flow leaving the Upper Colorado River Basin at Lees Ferry, Ariz.

The project would provide more uniform flows in the Dolores River below McPhee Reservoir by storing and diverting part of the high spring flows and releasing water to augment the low summer and fall flows. Flows during the winter would be essentially unchanged (see Table A-14). By storing much of the high runoff of spring, McPhee Reservoir would reduce flood related damages by an average of about $50,000 annually.1/

The project would also affect streamflows above the town of Dolores. With irrigation storage provided in McPhee Reservoir, it is anticipated that the Montezuma Valley Irrigation Company would reduce fluctuations in Groundhog Reservoir and maintain a high water level, which would provide increased flows in Groundhog Creek during the spring. In the summer and fall, flows would normally be reduced, since releases for nonproject irrigation would be necessary only during dry years. These changes would be reflected in parts of the West Dolores and Dolores Rivers. Table C-1 summarizes the effects of the project on Groundhog Creek and the Dolores River from April through October during representative dry, normal, and wet years. The flows shown represent spills, since they are based upon keeping Groundhog Reservoir full.

In the San Juan River Basin, the project return flows would increase the annual runoff in local drainage channels, many of which are now dry during the summer and fall. Monument Creek, Cross Canyon, and Hovenweep Canyon drain most of the Dove Creek area and have flows only during spring runoff or storms. The project would add a total of about 8,720 acre-feet annually to these channels, primarily during the irrigation season. An additional 11,800 acre-feet would enter Yellow Jacket Canyon, McElmo Creek, and Navajo Wash as a result of return flows from all three portions of the project areas. Much of the Towaoc area is drained by three dry channels--Aztec Wash, Cowboy Wash, and Coyote Wash. The project irrigation return flows would add a total of 4,480 acre-feet to the drainages during the irrigation season. Table C-2 shows the estimated effects on the drainage systems.

1/ Correspondence from the Department of the Army, U.S. Corps of Engineers to the Bureau of Reclamation, November 20, 1974.

Dollar value based on 1974 price levels, a 3 1/4 percent interest rate, and a 100-year period of analysis.

Table C-1
Streamflows with and without the project
Groundhog Creek and Dolores River at Dolores
(second-feet)

	Wet year (1962)		Normal year (1962)		Dry year (1959)	
	Pre-project	Post-project	Pre-project	Post-project	Pre-project	Post-project
Groundhog Creek						
April	90	100		70		10
May	110	160		110		20
June	70	70		40		10
July	50	10	40	10	60	60
August	120	10	160		10	60
September	30		40		20	50
October	20	10		10		10
Dolores River						
April	1,950	1,960	1,110	1,180	180	190
May	2,560	2,610	1,550	1,660	660	680
June	1,940	1,940	1,210	1,250	440	450
July	420	380	370	340	120	120
August	260	150	230	70	140	190
September	110	80	120	80	80	110
October	80	70	90	100	90	100

5. Water Quality

a. Dolores River Below McPhee Reservoir

Water quality in the Dolores River below McPhee Reservoir would be occasionally degraded during the 5-year construction period of the dam as a result of increased turbidity and sedimentation from clearing in the reservoir basin and from borrow areas. The high flows of spring and early summer, however, would clean out most of this material from the streambed. Water quality could also be adversely affected by point sources of wastewater, such as aggregate processing, concrete batching, and foundation draining, although these waters would be treated before being allowed to enter the river. Sanitary wastes would have no impacts on water quality, since they would be removed to approved sites for disposal.

The greater uniformity of flows provided by the project would generally improve the quality of water downstream. The reservoir would remove the high turbidity characteristic of spring runoff, and the increased summer flows would also improve the quality downstream. Below Paradox Valley, about 105 miles downstream, the improvement would be particularly noticeable. High saline ground water surfaces and enters the river in the valley, as discussed in Section A-3, and causes a large deterioration when river flows are low during the summer. The project, by providing increased summer flows, would dilute the ground water and decrease the salt concentration below the valley.

Table C-2
Project return flow in
Local tributaries of San Juan River

Local drainage to San Juan River	Area drained (acres)	Average existing flow (sec.-ft.)	Predicted return flow entering tributaries: Average annual acre-feet	Maximum in September (sec.-ft.)	Minimum in April (sec.-ft.)	Quality of return flow (mg/1)6/
Monument Creek	1,640	intermittent	790	1.5	0.7	600
Cross Canyon	16,878	intermittent	6,520	12.8	6.2	600
			1/750			500
Hovenweep Canyon	1,642	intermittent	660	1.3	.6	600
Yellow Jacket Canyon	12,900	2/13	3,900	7.9	3.4	1,030
McElmo Creek3/	21,100	45.9	3,850	8.4	2.6	2,360
			4/3,100			500
Navajo Wash	697	3	450	.9	.4	6,650
			5/500			500
Aztec Wash	590	intermittent	380	.9	.2	8,440
Cowboy Wash	1,091	intermittent	800	1.8	.5	5,700
Coyote Wash	5,126	intermittent	3,300	6.8	2.6	8,510

1/ Municipal and industrial return flow from Dove Creek area.

2/ Flow measured at Colorado-Utah State line. Includes intermittent flows from Hovenweep Canyon.

3/ McElmo Creek at Colorado-Utah State line.

4/ Municipal and industrial return flow from Cortez area.

5/ Municipal and industrial return flow from Towaoc area.

6/ Quality of return flow shown is estimated to be the highest for project operation and occurs during approximately the fourth year of operations. Quality improves gradually thereafter.

b. McPhee Reservoir

During the initial filling, the reservoir could have a high turbidity, but this would soon disappear. Nutrient levels present during filling would be beneficial, aiding in the development of a productive biological community. Local algae blooms of a very limited nature are also expected. Since the reservoir would not be receiving constant nutrient loading from the Dolores River, nutrient levels would not be high enough to promote eutrophication. Considering the water exchange rate, the physical nature of the storage basin, and the use of the multilevel outlets, the possibility of stratification problems would be remote. As discussed in Chapter B, the alkalinity (pH of 8.1), hardness, and overall quality of the water would create conditions under which the heavy metals and toxic compounds present would occur in precipitated forms and consequently be biologically unavailable and pose no danger.

The removal of the Dolores wastewater treatment plant would reduce the possibility of occasional nutrient surge into the reservoir, thereby enhancing the suitability of the project water for municipal and industrial use, recreation, fish and wildlife, and aesthetics. With an improved plant constructed by the water users to meet State and Federal standards, nutrient and coliform bacteria concentrations would decrease, thus reducing any possible eutrophication and health problems that may now exist. The level of biological oxygen demand (a measure of organic pollution) would also decrease, thus improving the water quality.

c. San Juan River Basin

(1) Return Flow Quality

The average annual project return flows of 25,000 acre-feet would carry 17,210 tons of salts contained in the diverted water and an additional 10,080 tons picked up during project uses. Municipal and industrial use would account for about 1,450 tons of the annual pickup. The remaining 8,630 tons would be contributed by full service irrigation, consisting of 12,600 tons picked up in the Towaoc area minus 3,970 tons deposited in the Dove Creek area. No additional salts would be picked up by supplemental service irrigation.

In the Montezuma Valley area, the present water supply is usually in excess of irrigation requirements in the spring and early summer and inadequate in the late summer and early fall. Excessive amounts of water are consequently applied during the spring and early summer, leaching salts from the soil. Under project conditions, a more uniform amount of water would be supplied and better irrigation methods could be used, resulting in no significant increase in the amount of salt picked up from the soils.

The salts would be picked up in the Towaoc area by the gradual leaching of the saline soils. Over a period of time, much of the salt would be removed and the soils would reach an equilibrium with the chemical quality of the irrigation water, thus gradually decreasing the salt pickup. Bureau of Reclamation studies indicate that the pickup would vary from 4.1 tons per acre in the fourth year of operation to less than 0.5 ton per acre annually after the 80th year.

In the Dove Creek area, the soil is very low in soluble salts, and salts from the irrigation water would consequently be deposited as the water and the soil gradually reached equilibrium. Bureau studies estimate the annual rate of deposition at 0.14 ton per acre, composed primarily of lime ($CaCo_3$). The deposits would have no adverse effects on the agricultural value of the land.

Figure C-1 shows the predicted salt pickup from the Towaoc and Dove Creek areas over a 100-year period. The weighted average of the two areas would result in an overall project rate of about 0.8 ton per acre in the fourth year. The pickup would gradually decrease, and after about the 80th year the net effect would be a slight deposition of salt, with the return flows carrying less salt than the diverted water.

The increased use of pesticides and fertilizers on project lands would have a minimal impact on water quality. Studies have shown that pesticides used with irrigation have little impact on surface and ground waters. Some degrade rapidly and pose little or no problem. Others are strongly absorbed in clay and organic matter and can enter the surface water system on eroded sediment, but the amount of sediment eroded from irrigable land should be low, particularly on the full service lands which would be sprinkler irrigated and managed under irrigation scheduling. The Environmental Protection Agency, in studies of the Lower Colorado River from 1968 to 1973,[1/] concluded that receiving waters can be protected from pesticide pollution even in the presence of increased pesticide usage.

The application of nitrogen fertilizers to irrigated crop lands in the project area would result in a minimal increase of nitrates or nitrites in surface water and ground water for a variety of reasons. Leaching of nitrates appears to be small in the presence of a growing crop because of the plant's rapid intake of nitrates and free water in the soil. It has also been demonstrated that the total amount of nitrates leached from the fallowed soil is considerably greater than from a soil with growing plants. Irrigation would significantly reduce the fallow acreage in the Dove Creek area.

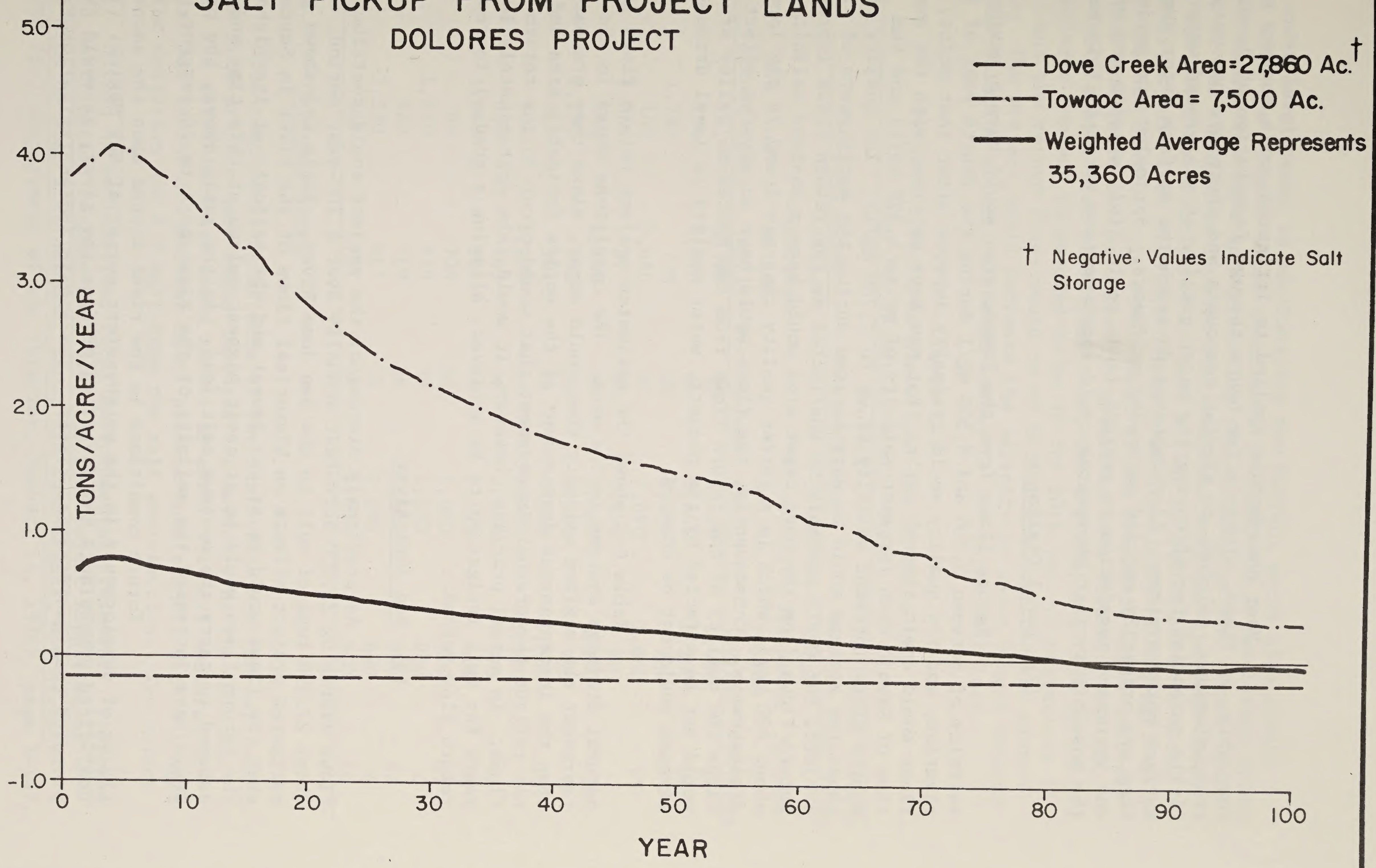
Sprinkler irrigation practices reduce deep percolation and consequently the movement of inorganic nitrogen into ground water. Therefore, under project operations on full service lands most applied nitrogen not used by plants would remain in the soil. The application of nitrogen fertilizers on supplemental service land should not increase greatly, and the deep percolation associated with excessive irrigation in mid-season in anticipation of late season water shortages could actually be reduced with an assured late season water supply under project operations.

1/ U.S. Environmental Protection Agency, Report on an Investigation of Pesticides Pollution in the Lower Colorado River Basin - 1973 (December 1973)

FIGURE C-1

SALT PICKUP FROM PROJECT LANDS

DOLORES PROJECT



Most phosphorous applied to irrigated soils becomes water insoluble, or fixed, within a few hours through formulation of insoluble iron, aluminum, calcium, or similar compounds and therefore has very little potential for affecting the water quality of the ground water or surface water systems. If phosphates do reach the surface water system they are primarily carried on eroded sediments. Sprinkler irrigation and increased vegetation on project lands would limit erosion and minimize the possibility that phosphates could reach surface water by this means.

(2) Local Drainages

Return flows from the Towaoc area would have a maximum salinity of between 5,700 and 8,500 mg/l during the fourth year of irrigation, and the quality would gradually improve after that point. The flows would drain through washes that now have no flow, with the exception of Navajo Wash (present salinity of up to 6,328 mg/l) and the Mancos River (present salinity of up to 2,780 mg/l). The quality of these two streams would be deteriorated during the early years of the project, but would probably be unaffected as the return flows improved. Return flows from the Dove Creek area would have a maximum salinity of about 600 mg/l, which is a better quality than now found in the local drainageways. Consequently, the flows would have no adverse effect. Since the quality of the return flows from the Montezuma Valley area would not be affected by the project, water quality in local drainage streams would not be changed.

Table C-2 shows the estimated project return flows in the natural drainage systems in the area. The conditions shown in the table represent the maximum salinity that could occur, since they are based upon the instantaneous development of the entire irrigable area and do not reflect the gradual improvement that would occur in the return flows. In actual practice, however, it would take approximately 10 years for full irrigation to be achieved, allowing a gradual increase in return flow volume.

(3) San Juan River

As previously discussed, the project would contribute return flows averaging 25,000 acre-feet annually over a 100-year period, carrying about 27,290 tons of salt to the San Juan River. Table C-3 shows the estimated project effects on historical flows of the river in September, when the flows would be at the lowest and the salinity at its highest. The return flows would be at their highest volume at this time and are assumed to carry the maximum salt load. As the table shows, the project would have increased the salinity of the river by 4 to 26 percent.

Future conditions in the river depend upon the amount and timing of developments in the northwestern corner of New Mexico. Two coal-fired powerplants now divert water from the river, as would two proposed coal gasification plants. The Navajo Indian Irrigation Project, now under development in northwestern New Mexico, would also divert water from the river. These developments would have a cumulative effect of decreasing the flow and increasing the salinity of the river. Estimates of the cumulative impacts are available only for the year 2005, when the river is anticipated to have a flow of 1,500,000 acre-feet, annually, a salt load of 830,000 tons, and a salinity of 408 mg/l at Shiprock, New Mexico, Full development of the proposals would decrease the flow and increase the salinity, resulting in a flow of 1,130,000 acre-feet, a salt load of 975,000 tons, and a salinity of 636 mg/l.[1] The Dolores Project is assumed to be in the 20th year of operations in 2005, and the return flows would be of better quality than the riverflows. The project would decrease the salinity by about 3 mg/l because of this diluting effect, although adding to the total salt load.

Table C-3
Project effects on historical low flows of the
San Juan River at Bluff, Utah

	San Juan River		Project return flows		Estimated effects on San Juan River	
Year	Low flow (second-feet)	Total dissolved solids (mg/l)	Second-feet	Total dissolved solids (mg/l)	Total dissolved solids (mg/l)	Percent of increase
1959	141	1,780	36	2,690	1,960	10
1960	199	1,000	36	2,690	1,260	26
1961	1,786	738	36	2,690	780	5
1962	165	1,440	36	2,690	1,660	15
1963	1,069	877	36	2,690	940	7
1964	548	1,160	36	2,690	1,250	8
1965	2,292	532	36	2,690	560	6
1966	615	901	36	2,690	1,000	11
1967	606	1,200	36	2,690	1,280	7
1968	630	765	36	2,690	870	14
1969	1,649	561	36	2,690	610	8
1970	767	708	36	2,690	800	13
1971	1,610	938	36	2,690	980	4
1972	810	719	36	2,690	800	12
1973	3,230	617	36	2,690	640	4
1974	561	791	36	2,690	900	14

d. Colorado River

The concentrating effects of the depletions and the salt contributions from project uses would increase the salinity of the Colorado River. The total increase would amount to about 9.4 mg/l measured at Imperial Dam (about 1.1 percent above present conditions), with 8.4 mg/l from the depletion and 1.0 mg/l from the salt contribution. The effect of the depletions would be constant during the life of the project, but that of the salt loading would decrease from a high of 2.7 mg/l after 4 years to no apparent effect after 80 years (see Figure C-2). The estimated effects of the project are based on the conditions at Imperial Dam outlined in the Bureau of Reclamation's Quality of Water, Colorado River Basin, Progress Report No. 6 (U.S. Department of the Interior, January 1973). The report shows the modifications of stream conditions to December 1970. The conditions have been further modified to reflect the impacts of all developments constructed since 1970 or currently under construction and the salinity increases resulting from the project have been computed as if it were the next development constructed.

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[1] Bureau of Reclamation, Final Environmental Statement: Proposed Western Gasification Company Coal Gasification Project Expansion of Navajo Mine by Utah International Inc., San Juan County, New Mexico, Int. FES 76-2 (Department of the Interior, January 14, 1976), page 3-147.

Recent studies by the Bureau of Reclamation conclude that increasing salinity causes both direct and indirect economic losses in the Lower Colorado River Basin. The damages, estimated at $230,000 annually for each increase of 1 mg/l at Imperial Dam, have a number of causes. In agriculture, they arise from decreased crop yields, increased leaching requirements, increased management costs, and application of various adaptive practices. In the municipal and industrial sector, the detriments arise primarily from increased water treatment costs, accelerated pipe corrosion and appliance wear, increased use of soap and detergents, and decreased potability of drinking water.

e. Summary of Impacts

The water quality in the San Juan River and the Colorado River Basins below the project would not be significantly affected by the increased use of pesticides and fertilizers on project lands. In the initial years of project operation, however, salts would be carried into the Colorado River by project return flows and would thereby reduce the quality of the water for agricultural and municipal and industrial users in the Lower Colorado River Basin. In time, as the salts were gradually leached from the project soils in the Towaoc area, the influence of the project on the water quality in the lower basin would be negligible.

6. Fish and Aquatic Invertebrates

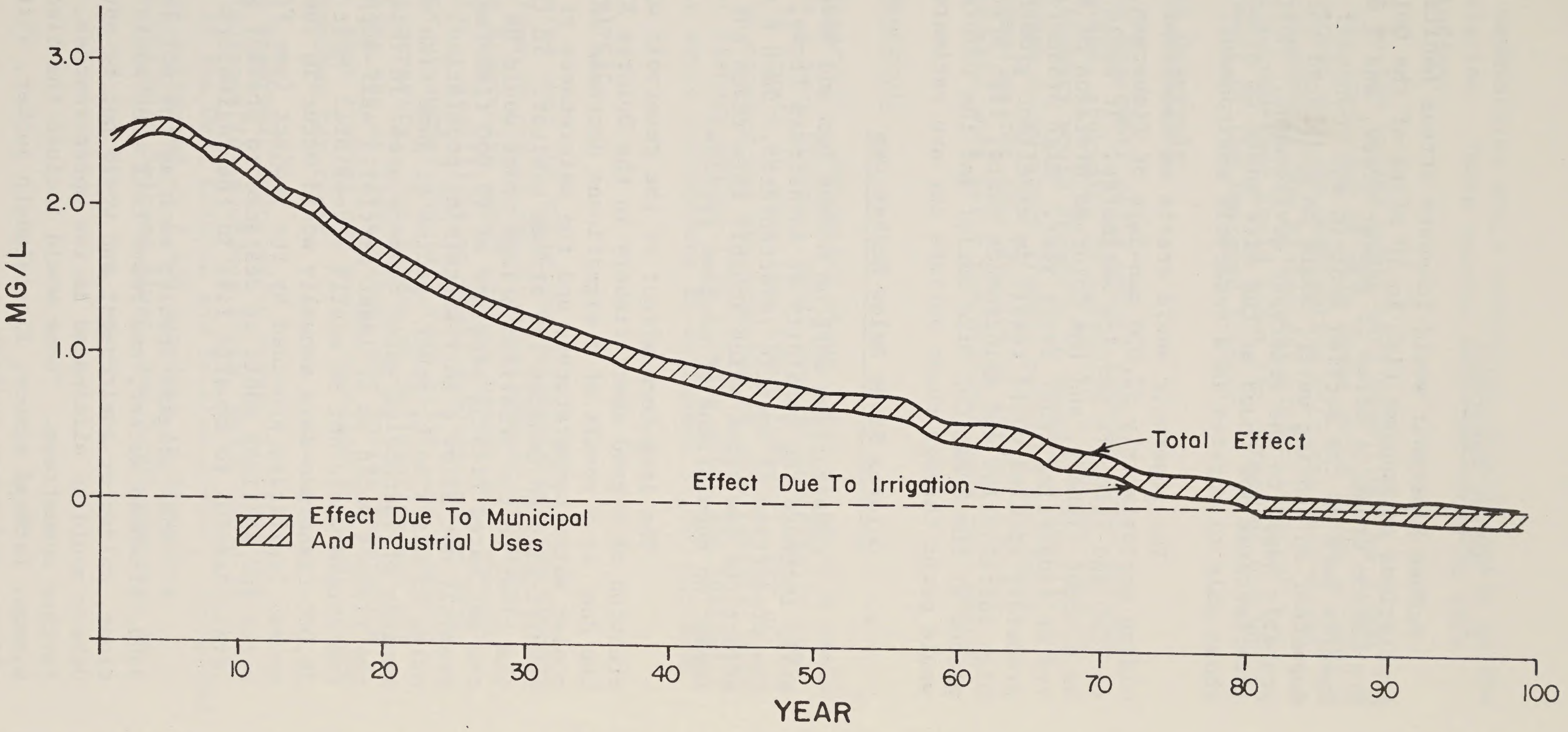
a. Introduction

By providing storage facilities, the project would create new trout fisheries in the three proposed reservoirs and the Dolores River below McPhee Dam. It would also enhance existing fisheries in the Montezuma Valley Irrigation Company's Groundhog Reservoir, Groundhog Creek below the reservoir, part of the West Dolores River, and part of the Dolores River above McPhee Reservoir. Some species of nongame fish in the Dolores River below McPhee Reservoir would be adversely affected, while others would remain essentially as they are. Fisheries in the San Juan River and its tributaries would not be affected. The following sections describe the anticipated impacts at each location.

FIGURE C-2

SALT LOADING EFFECT
AT
IMPERIAL DAM

DOLORES PROJECT



b. McPhee Reservoir

McPhee Reservoir would inundate stream habitats that now support populations of nongame fish in 10 miles of the Dolores River, 1 mile of Dry Canyon Creek, 4 miles of Beaver Creek, and 1 mile of Plateau Creek. Species such as the mottled sculpin and roundtail chub, which are dependent on running water, would be displaced but other species would probably adapt to the reservoir environment. Most species of aquatic invertebrates now found at the site would be eliminated and replaced by those able to survive in a reservoir environment.

The reservoir would create an excellent sport fishery, providing approximately 52,000 man-days of fisherman use annually according to Fish and Wildlife Service estimates. It would be managed primarily as a trout fishery, and the Colorado Division of Wildlife plans to stock fry or fingerling trout every year. High productivity and lack of predatory species would result in excellent growth rates. Because of high installation and maintenance costs, fish screens would not be placed at the Great Cut Dike outlet and the Dolores Tunnel. Fish losses would occur through these outlets but are estimated to be insignificant.

c. Dolores River Below McPhee Dam

Construction work on McPhee Dam and Reservoir would temporarily increase the turbidity of downstream flows, which would decrease the production of aquatic invertebrates. Such a change would adversely affect the few trout which inhabit this reach but should have little impact on populations of nongame species.

The long-term effect of the reservoir operations would be creation of a good sport fishery in the Dolores River downstream from the dam as a result of a significant decrease in stream turbidity, cooler water temperatures, and the maintenance of year-round flows specifically to enhance the stream habitat. In the first 11 miles of the river to the Bradfield Bridge trout would be stocked annually, since the estimated fishing pressure of 10,000 fisherman-days annually would probably not allow a self-sustaining population. In the remaining 45 miles to Slick Rock, other species of game fish would also be stocked because of increasing water temperatures. In this section of the stream the fishery would be at least partially self-supporting because most of the stream would not be easily accessible. Most of estimated use of 28,000 fisherman-days annually would occur in the vicinity of the four access facilities provided by the project (see Figure A-15). The outlet works and spillway would be designed to prevent gas supersaturation levels harmful to aquatic life in the tailwaters below McPhee.

Some nongame species such as the mottled sculpin, speckled dace, bluehead sucker, and round tail chub would be able to adapt to a clear, coldwater environment and would not be adversely affected. Others would be eliminated in the upper reaches, but would be maintained farther downstream. These would include the black bullhead, brassy minnow, fathead minnow, flannelmouth sucker, white sucker, carp, red shiner, and green sunfish.

Mayflies and caddisflies would contribute significantly to the total invertebrate population. These species were not found in this reach during project studies.

High releases in the spring would vary from 1,000 to 2,500 second-feet. Flows at the lower end of this range would flush accumulated silt from the riverbed and, in combination with the year-round releases at McPhee, would enhance the biological productivity of the stream. Flows of 2,500 second-feet could scour the streambed but would not prevent the development of the improved fishery.

d. Monument Creek Reservoir

Monument Creek Reservoir would create fishing opportunities where none presently exists, providing an estimated 1,500 man-days of fishing annually. The fishery would probably be managed primarily for warm water species although a two-stage fishery could be developed. Such a fishery would depend on the availability of catchable-sized trout, which would be stocked when water temperatures were cool enough in the spring.

e. Dawson Draw Reservoir

Dawson Draw Reservoir, inundating about 1 1/2 miles of a small stream that now supports a poor fishery, would have an essentially constant shoreline and would create an excellent trout fishery. Fry or fingerling trout would be stocked and are expected to grow rapidly, producing a catchable trout fishery within 1 to 2 years after the initial stocking. The reservoir would accommodate an estimated 35,000 man-days of fishing annually.

f. Groundhog Reservoir

It is anticipated that the Montezuma Valley Irrigation Company would modify its operations to reduce the fluctuations at Groundhog, Narraguinnep, and Totten Reservoirs under project conditions, thereby improving the fish habitat. Stabilization would produce cooler water temperatures, less danger of summer and fall fish kills, and a general increase in the carrying capacity. The Bureau of Reclamation has not projected increased fishing use at Narraguinnep and Totten Reservoirs. It anticipates, however, that fishing use would increase by about 17,600 man-days annually at Groundhog Reservoir.

With Groundhog Reservoir operated to reduce fluctuations, downstream flows would increase in Groundhog Creek, which would in turn increase flows in parts of the West Dolores and Dolores Rivers. Increased fishing opportunities are estimated at 2,400 man-days in Groundhog Creek, 4,000 man-days in the West Dolores River, and 1,600 man-days in the Dolores River.

g. San Juan River

All return flows from irrigated land would drain into the San Juan River, as pointed out earlier, increasing the flow and decreasing the salt concentrations. Since the overall effect would be to slightly improve water quality, no significant impact on aquatic organisms in the San Juan River is expected.

7. Terrestrial Wildlife

a. General

Project construction and operation would affect wildlife and wildlife habitat. Although certain impacts would be directly attributable to the project, others would indirectly result from the use of project water and facilities. Table C-4 lists the long-term changes in habitat that would occur at each of the proposed features. Additional habitat would be temporarily disturbed during construction but would recover.

Construction activities would disturb wildlife during the 9 years required to construct the project, largely because of noise, dust, blasting, the activity of men and equipment, and the temporary removal of vegetation in work areas. In addition to removing cover and food, the work would affect big game animals on their range during the winter and interrupt the breeding and rearing periods of other species during the spring and summer. Although some species could avoid the construction areas, they would be displaced onto adjacent land which in some instances is already at carrying capacity, thus resulting in a loss of some animals as well as a deterioration of the habitat. Other species which are less mobile, such as reptiles, amphibians, and other small animals, would suffer losses at the construction sites.

Long-term impacts would vary according to species. Big game populations would be essentially unchanged. The project would provide an overall increase in habitat for waterfowl and shorebirds, gamebirds, and most furbearers, but would noticeably decrease the available habitat for prairie dogs, bobcats, and reptiles. Small losses would also occur in habitat for raptors, small game and nongame mammals, and reptiles.

b. Big Game Mammals

(1) Mule Deer

Project development would cause some short-term losses of deer but would not have significant adverse effects after the wildlife management area at McPhee Reservoir was fully developed. McPhee Reservoir would remove about 4,500 acres of winter range which is in poor to fair condition and now supports about 600 deer. Associated developments for recreation and access would remove an additional 360 acres. Animals now

Table C-4

Long-term habitat changes of the Dolores Project

Feature and present habitat	Acres required	Acres affected	Habitat with project
McPhee Reservoir			
Reservoir basin			
Native pasture	816	816	Open water and foreshore
Dry crop land	197	197	Open water and foreshore
Irrigated crop land	989	989	Open water and foreshore
Riparian	448	448	Open water and foreshore
Pinon-juniper	1,619	1,619	Open water and foreshore
Gravel pit	86	86	Open water and foreshore
Waste land	75	75	Open water and foreshore
River	240	240	
Subtotal	4,470	4,470	
Roads			
Dry crop land	8	8	Roads (no habitat)
Pinon-juniper	38	38	Roads (no habitat)
Recreation area			
Pinon-juniper	290	290	Landscaped recreation area
Waste land	20	20	Landscaped recreation area
Wildlife management area			
Native pasture	230	230	Improved wildlife habitat
Dry crop land	402	402	Improved wildlife habitat
Pinon-juniper	3,518	3,518	Improved wildlife habitat
Scenic and wildlife easements			
Pinon-juniper	928		No change
Great Cut Pumping Plant			
Pinon-juniper	2	2	No habitat
Reservoir right-of-way			
Native pasture	614		No change
Dry crop land	205	203	Successional habitat changes
Irrigated crop land	1,031	1,029	Successional habitat changes
Riparian	529		No change
Pinon-juniper	3,176		No change
Gravel pit	84	82	Successional habitat changes
Waste land	97		Waste land
River	32		River
Total	15,674	10,292	
Dolores River			
Recreation areas (riparian)	78		No change
Streamside easements (riparian)	57		No change
Total	135		
Dolores Tunnel			
Pinon-juniper	7	3	No habitat
Dolores and Towaoc Canals			
Intermountain wood land	44	37	151 acres of canal and road; remaining 480 acres reseeded for upland game and nongame habitat
Irrigated crop land	150	128	
Pinon-juniper	250	212	
Grass land	306	260	
Total	750	637	

Table C-4 (Continued)

Long-term habitat changes of the Dolores Project

Feature and present habitat	Acres required	Acres affected	Habitat with project
Dove Creek Canal			
Intermountain wood land	41	35	137 acres of canal and road; 273 acres reseeded for upland game and nongame habitat
Irrigated crop land	71	60	
Pinon-juniper	101	85	
Dry crop land with scattered pinon-juniper	270	230	
Total	483	410	
South Canal			
Dry crop land with scattered pinon-juniper	95	75	26 acres of canal and road; 49 acres reseeded for upland game and nongame habitat
Cortez-Towaoc Pipeline			
Irrigated crop land	10		No change
Pinon-juniper	6	6	No habitat
Dry crop land	7		No change
Waste land (existing highway right-of-way)	48		No change
Total	71	6	
Monument Creek Reservoir			
Reservoir basin			
Native pasture	6	6	Open water and foreshore
Seeped pasture	32	32	Open water and foreshore
Dry crop land	46	46	Open water and foreshore
Recreation areas			
Seeped pasture	7	7	Landscaped area with shade trees
Dry crop land	3	3	Landscaped area with shade trees
Fish and wildlife areas			
Seeped pasture	21	21	Upland game food plots
Dry crop land	54	54	Upland game food plots
Reservoir right-of-way			
Native pasture	36		No change
Seeped pasture	12		No change
Dry crop land	155		No change
Total	372	169	
Dawson Draw Reservoir			
Reservoir basin			
Irrigated crop land	2	2	Open water and foreshore
Wet lands	73	73	Open water and foreshore
Native pasture	219	219	Open water and foreshore
Recreation facilities			
Native pasture	2	2	Parking lots
Reservoir right-of-way			
Irrigated crop land	116	116	Successional habitat changes
Pinon-juniper	10		Unchanged
Native pasture	461		Unchanged
Wet lands	189		
Total	1,072	412	

using the area would de displaced to surrounding winter range which, in its present condition, cannot be expected to support the increased capacity. In the long-term, however, the development of the wildlife management area would increase its carrying capacity enough to compensate for the lost habitat and to maintain the overall deer population of the project area at about its present level. The reservoir would also cause temporary losses from deer attempting to swim the reservoir or cross on thin ice. Such losses cannot be estimated, but should be considered significant since the reservoir would create a 10-mile-long barrier to traditional migration routes accross the Dolores River. Eventually the deer would establish new migration routes around the reservoir.

The paved access road to McPhee Dam and the Dolores River would be conducive to high speed travel, and deer could be lost in collisions with vehicles, particularly where the highway borders the wildlife management area. By serving as a focal point for winter sportsmen, the recreational areas would be less desirable for deer winter range than at present but the use of the areas is not expected to result in a decline of deer populations. Deer habitat would be beneficially affected by the acquisition of 420 acres of private land on the east side of McPhee Reservoir. By ensuring that land uses on the area would not change, the easements would prevent a probable future loss of valuable habitat.

Monument Creek Reservoir would have little effect on deer since the grasses and dry crops now at the site do not provide important winter range. The 75-acre wildlife area, although managed specifically for upland game, may be used by migrating deer. Dawson Draw Reservoir would also have little effect on winter range, although human activity at the site may affect a migration route and force the deer to detour. Food plots planted for upland game and waterfowl may be used by deer.

The project canals should not have significant effects on deer. The Dove Creek Canal, which would have the greatest length, width, depth, and velocity of flow, would cross several migration routes and would consequently have the greatest impact on deer movement. With the exception of fawns, the animals should have little trouble crossing the canal once they became familiar with it. Only fawns from the relatively small resident herd should be affected, however, since most fawning occurs at higher elevations to the northeast of the project area. The Dolores and Towaoc Canals would traverse areas with smaller deer populations and would not be expected to be barriers to migrating animals.

Two factors would tend to decrease the impacts of the project canals on deer. First, they would carry irrigation water only from April through October, when most deer are on their summer ranges at higher elevations. Second, the canals would generally be earthlined, allowing deer to climb the banks. Only about 15 of the approximately 94 miles of canal would have concrete lining. The largest concrete-lined section, 10 miles at a capacity of 135 second-feet, would be located on the Towaoc Canal at McElmo Creek and would have an 8-foot deer fence on both sides. With a side slope of 1.5:1, the canal even when empty could be crossed by fawns although the capacity may render it hazardous to any deer when full. A very short reach (62 feet) on the Dolores Canal, with a capacity of 70 second-feet would be too small to present a barrier. The last 4 miles of the Dove Creek Canal and 1 mile of the South Canal, although concrete-lined, would have capacities of less than 50 second-feet and would also be too small to create problems for migrating deer.

The conversion to irrigated farming in the Dove Creek area would cause an increase in production of alfalfa, which is more susceptible to damage by deer than are the dry-farmed crops. The animals are attracted by forage, haystacks, and other cultivated feeds during the winter and early spring, when natural food is limited. Initial and possibly significant crop damage may occur as a result of the decrease in winter range, but this damage would decrease as management efforts increased the carrying capacity of the wildlife management area. Irrigation in the Towaoc area may attract a few deer from Ute Mountain and the Mancos Canyon, but the extent should be insignificant since the cover and forage of the surrounding area is very poor and deer use is consequently small.

Overall, the project would have insignificant adverse effects on deer after the wildlife area was developed to its expected carrying capacity. Most of the long-term effects would result from increased disturbance by human activity and collisions with automobiles at McPhee Reservoir. In other parts of the area, the long-term impacts would also be insignificant.

(2) Elk

McPhee Reservoir would have no long-term impact on the size of the elk population. Although inundation would remove winter range that now supports about 300 elk, the wildlife management area would provide enough carrying capacity to offset the loss. Some animals would probably be lost, however, before the development of the wildlife area was completed. The reservoir would also inundate two elk migration routes on the Dolores River. Since these routes are used throughout the winter, some drownings would occur until the animals established new routes around the reservoir.

The construction of roads and recreation sites would have essentially the same effects on elk winter habitat as they would on deer because of the overlap in their winter ranges. The disturbances probably would be greater for elk since these animals are generally less tolerant of human intervention. The conversion of dry land to irrigated crops is expected to attract elk, and crop damage could occur before the wildlife management area was developed. Other project features are not expected to have a measurable effect on elk since they would not be located on elk winter range or migration routes.

c. Mountain Lion and Black Bear

Specific effects on the mountain lion are not readily predictable because of the animal's extensive range and dependence on a large variety of prey. Some lions could be displaced, but the project is not expected to reduce the amount of prey or the mountain lion population. A hunting route located south of Dolores would be altered by the presence of McPhee Reservoir, and the large increase in human activity would also reduce the lion's present range.

The project could adversely affect the black bear. McPhee Reservoir would inundate some habitat, and increased human activity could force bears to relocate on adjacent lands. Recreation areas could attract some bears to the area because of the possibility of a new food source, perhaps leading to their removal by trapping and relocating. The net effect would be an insignificant decrease in the population of bears in the area.

d. Small Game Mammals

The only small game mammal noticeably affected would be the desert cottontail, whose habitat would be increased by the project. Although McPhee Reservoir would remove habitat supporting about 100 cottontails and Monument Creek and Dawson Draw Reservoirs would displace a very small number of animals, the Monument Creek wildlife area would provide enough food and cover to result in an overall increase in the population. Canals, pumps, roads, and other project features would destroy some game habitat, but planned seeding for food and cover would compensate for the losses. The conversion of dryland farms to irrigation would benefit cottontails by the establishment of permanent cover, and irrigation return flows would increase forage and cover production along waterways. No significant effect is expected on the snowshoe hare, chickaree squirrel, or Abert's squirrel since their respective habitats within the project area are small.

e. Furbearers

The project would significantly increase the amount of habitat available for the beaver and muskrat in the area. Releases from McPhee Reservoir would provide an excellent habitat in the Dolores River although the reservoir itself would probably be used only lightly because the fluctuating water level would not provide a good habitat. Dawson Draw Reservoir would provide suitable habitat for the muskrat since the stable water level would result in abundant riparian and aquatic vegetation, but it would also inundate grasses and marsh that already support a good population.

McPhee Reservoir would decrease populations of skunks and weasels by destroying their food sources and cover. The omnivorous food habits of the skunk would enable it to better adapt to a changing environment, however, and suitable habitat would be created around recreation areas where new food sources would be created. Permanent streamflows below McPhee Dam would increase riparian vegetation and may attract mink to the area. Because of limited habitat and small populations within the McPhee area, no other furbearers would be significantly affected by inundation.

Dawson Draw Reservoir would inundate an area that now attracts substantial populations of skunks, but the vegetation expected around the reservoir could support displaced populations. Food patches planted in conjunction with the wildlife area would increase populations of rodents, thereby providing additional food sources for weasels and gray foxes.

Monument Creek Reservoir would inundate cropland which supports few furbearers, and impacts are consequently expected to be negligible. A greatly fluctuating shoreline would prevent the growth of aquatic vegetation and offer little habitat for aquatic furbearers.

Habitat would be lost in the change from dryland to irrigated farms, and the effects on furbearers using these areas would depend upon the amount of permanent cover left undisturbed. Return flows in adjacent drainages would increase available cover. The project canals, pumping plants, and roads would also decrease furbearer habitat, although planned reseeding of areas adjacent to these features should more than compensate for the habitat lost. The side slope ratios of 1.5:1 on concrete-lined sections of canals should allow most furbearers to escape, with the exception of very young animals.

f. Varmints

McPhee Reservoir would inundate a colony of prairie dogs near Great Cut Dike and substantial habitat for the blacktail jackrabbit, porcupine, and rock squirrel. The loss of these species would thereby reduce the hunting range of the coyote, bobcat, and raccoon. Although the bobcat would decrease in population because of this loss, the coyote is more able to adapt to a changing environment and would probably be affected only slightly. Increased riparian growth and permanent streamflows below McPhee Dam should provide adequate habitat for displaced raccoons, which may also use the edge of the reservoir as a feeding area.

At Dawson Draw and Monument Creek Reservoirs the change to a reservoir environment, the establishment of permanent vegetation, and the planting of wildlife food patches should have a beneficial effect for most varmints. Inundation would not have significant adverse effects, since the existing habitat in these areas supports few varmints.

The increase in irrigated crops would probably increase populations of jackrabbits, thereby providing additional prey for the coyote and bobcat. Any permanent cover established as a result of irrigation would also significantly enhance the hunting ranges of these larger varmints by increasing available cover and food sources for significantly larger populations of small rodents. The irrigation on the Ute Mountain Ute Indian Reservation would remove prairie dog habitat. Although farming practices would provide an excellent food source for prairie dogs, their burrowing habits would lead to extensive control measures on croplands and surrounding areas, and approximately 10,000 acres of habitat would be removed. Such measures would be coordinated by the U.S. Fish and Wildlife Service to avoid destruction of other species.

g. Nongame Mammals

Nearly all project facilities would remove habitat that supports nongame mammals, but this loss would be partially offset by the growth of permanent vegetation around the reservoirs and adjacent to irrigated land. This vegetation, combined with the reseeding operations along canal rights-of-way and the food plots at the wildlife management areas, would result in a net increase in habitat and in populations of nongame mammals.

h. Game birds

The project would have an overall beneficial effect on game bird habitat, primarily because of seeding along canal rights-of-way and the development of food and cover plots at Dawson Draw and Monument Creek Reservoirs. These provisions would more than offset losses of habitat through construction.

McPhee Reservoir would remove habitat used by the turkey, ring-necked pheasant, sage grouse, mourning dove, and band-tailed pigeon. Inundation would displace most of these species to suitable habitat on adjacent lands with exception of the sage grouse. This species is almost entirely dependent on a sagebrush community environment, and since little of this habitat exists nearby, would undergo a significant population decrease. The effects on the turkey and pheasant would not be significant, since their habitats within the reservoir basin are limited and larger inhabitable areas occur outside the site.

Additional habitat created by irrigation on lands previously dry farmed would benefit both upland and migratory game birds. The irrigation of previously arid land on the reservation would also provide additional cover and food, particularly for doves, where very limited amounts have existed in the past.

The impacts of the project on the blue grouse and sharp-tailed grouse are expected to be minor because their habitats are primarily outside the project area at higher elevations. Project effects on chukar are also expected to be minimal since little of their habitat is located at the sites of project features. Populations of Gambel's quail, which are considered almost nonexistent in the project area, may be enchanced by irrigation development on the reservation. This area is within the northern range of the species, but the lack of food, water, and cover limits its abundance.

i. Waterfowl and Shorebirds

Significant increases in habitat at McPhee, Monumunt Creek, and Dawson Draw Reservoirs would increase waterfowl and shorebird use, with a resulting increase in waterfowl hunting of approximately 3,200 man-days annually. It is anticipated that the existing Groundhog, Totten, and Narraguinnep Reservoirs would also increase surface area available for waterfowl and shorebird use. Project canals would benefit resident and migrant spring waterfowl by providing resting areas during the irrigation season. Irrigation would create valuable feeding sites for both waterfowl and shorebirds. The increased populations would cause more depredation on grain crops on both newly irrigated land and land now irrigated, particularly during late summer and early fall, when waterfowl begin migration.

j. Raptors

McPhee Reservoir would eliminate hunting and loafing areas in the river bottom presently used by the northern bald eagle, red-tailed hawk, great-horned owl, cooper's hawk, goshawk, kestrel, and golden eagle. This habitat loss would be partially offset by the presence of the reservoir, which would provide a food source in the form of fish, shorebirds, and waterfowl. Reservoirs are known to provide valuable habitat for bald eagles, and a significant wintering populations would be attracted by McPhee Reservoir during late fall and early winter. After the reservoir froze over, eagles would probably use the river below McPhee Dam. If a resident waterfowl population were established, peregrine falcons could possibly be attracted to the area. The enhancement of riparian vegetation below McPhee Dam would also provide additional feeding areas for many species of raptors.

Dawson Draw Reservoir would eliminate several hundred acres of hunting habitat used by raptors, but the adverse effect would be partially offset by the establishment of a waterfowl management area which would attract several species of raptors, especially the bald eagle, golden eagle, and peregrine falcon. Monument Creek Reservoir would have little effect on raptors, because its small size and fluctuating water level would provide little habitat.

Other project features should have very little effect on raptors, with some exceptions. The elimination of pinon-juniper woodland in association with roads and canals would reduce nesting areas for the sharp-shinned hawk and Cooper's hawk. Irrigation of presently dry-farmed land would produce additional cover and increase the populations of rodents available as prey. The reduction in prairie dog populations on the reservation would remove a food source for many raptors, but the increase in available food, water and cover caused by irrigation would increase carrying capacities for small rodents as prey. Increases in waterfowl and shorebirds at the existing reservoirs would provide additional prey for some raptors, although increased recreation would have an adverse effect on the use.

k. Nongame Birds

Because of the large number and diversity of species, effects that would be beneficial for one group may be detrimental for another. In discussing the impacts on nongame birds, attention is therefore given to the majority, rather than to each species. Riparian woodland is probably occupied by a greater abundance and diversity of birds than any other vegetation type, and the inundation of this habitat by McPhee

Reservoir would therefore displace a large number of nongame birds. Most of these species are migratory, and the greatest effect would be on breeding populations (i.e., summer residents), which would be forced to seek similar habitat elsewhere. The development of riparian vegetation below McPhee Dam would provide good habitat, although it could not replace the lost habitat at the reservoir site. Overall, an insignificant loss of nongame birds would occur.

The loss of existing marsh land with the construction of Dawson Draw Reservoir would have an adverse effect on a relatively small number of birds. The establishment of a wildlife management area, however, would attract a greater number and diversity of birds than are now found at the site.

Monument Creek Reservoir would enhance bird populations by providing water, which is a limiting factor in this relatively arid habitat. Growth of riparian vegetation, although limited because of a fluctuating shoreline, would also increase the populations.

The construction of canals, roads, pumping plants, and other project features would destroy habitat used by nongame birds, but revegetation plans and the addition of a water source would largely compensate for this loss. The change from dry farms and from arid grasses to irrigated farms would provide additional food, water, and cover.

1. Reptiles and Amphibians

Inundation by McPhee Reservoir would eliminate reptiles and amphibians using valley and woodland habitats in this area. Because of the fluctuating water level, the reservoir shore would not provide suitable habitat for most species associated with stable ponds. Dawson Draw Reservoir would also inundate habitat occupied by reptiles and amphibians but would provide much habitat around its edge for the wandering garter snake and for amphibians which presently occur at the site. Monument Creek Reservoir would eliminate habitat occupied by the desert short-horned lizard and Great Basin sagebrush lizard. It would provide an excellent breeding site for Utah tiger salamanders, red-spotted toads, Rocky Mountain toads, boreal chorus frogs, and western leopard frogs.

Other project features are expected to have little effect on reptiles or amphibians because of low population densities in these areas. An exception would be the Dove Creek Canal, which would reduce or eliminate small islands of natural vegetation. Species affected would be the Great Basin sagebrush lizard, northern plateau lizard, northern tree lizard, and wandering garter snake.

The project would have a detrimental effect on reptiles on the reservation. Many of the species inhabiting this area require prairie dog burrows for use as dens, and these burrows would be eliminated with cultivation, irrigation, and rodent control. This modification would completely change the species composition and reduce the diversity of reptiles. The northern side-blotched lizard and desert striped whipsnake would be the only reptiles able to adapt. The importation of water to this arid grassland, however, could favor Utah tiger salamanders, red-spotted toads, Rocky Mountain toads, western leopard frogs, and wandering garter snakes.

8. Threatened or Endangered Species

Studies have revealed the presence of only one endangered species, the peregrine falcon, within the project area. Although the effect of the project is considered to be minimal, the importance of this species requires that all of the foreseeable impacts be discussed.

Although existence of an aerie has not been confirmed, the area believed to be occupied by a pair of peregrine falcons is located on the Ute Mountain Ute Reservation, southwest of Cortez. Under the present policy of the Ute Mountain Ute Indian Tribe, access to the reservation is restricted to tribal members, with few exceptions. This policy would prevent essentially all disturbances from bird watchers and other individuals, even if access to the area were increased as a result of project features.

Construction activities near the suspected peregrine aerie during courtship, incubation, and rearing of young could cause the falcons to abandon the site. Researchers tend to disagree on the amount of human activity that can be tolerated by peregrines. Some feel that human activity produces no harmful effects, while others believe it to be a major cause of nest abandonment.1/ The amount of disturbance required to cause this abandonment cannot be predicted and probably differs with each pair of nesting birds. To minimize the possibility of abandonment, construction activities within the vicinity of the aerie would be avoided between February 1 and August 1 if peregrines attempted to reoccupy this site.2/ The net long-term effect of project irrigated land and reservoirs would probably be beneficial to peregrines by increasing the number of prey species available in the form of nongame birds, waterfowl, and shorebirds.

Historical sightings of peregrine falcons in the Dolores River Canyon between the Bradfield Bridge and Slick Rock indicate the possibility of future use of the area by this species.

Although no black-footed ferrets were found in the project area, the Ute Mountain Ute Indian Reservation contains a considerable amount of potential habitat. An estimated 50,000 acres of active prairie dog habitat surrounding the project lands and within the boundaries of the reservation would provide a buffer to any ferrets displaced by the project.

1/ Bureau of Land Management, Habitat Management Series of Endangered Species, No. 1 (1972)

2/ Rocky Mountain/Southwestern Peregrine Falcon Recovery Team, American Peregrine Falcon Recovery Plan, (1976) p. 26.

9. Vectors and Related Problems

The project would not have a significant effect on mosquitoes. Steep slopes at McPhee and Monument Creek Reservoirs would not be conducive to ponding during drawdown, and drainage channels would minimize ponding on gentle slopes. McPhee Reservoir would inundate 10 miles of the Dolores River, where pools remaining from spring floods now provide good habitat. Dawson Draw Reservoir would create standing water, but it would also inundate a marshy area that is already a habitat for mosquitoes. Irrigation should also have a minimal effect, since lined canals, sprinklers, buried pipe laterals, irrigation scheduling, and drainage facilities would result in minimal standing water. The project recreation facilities would expose larger numbers of people to both mosquitoes and ticks, and control measures could be possible for public health.

10. Historical and Archaeological Sites

The project would not adversely affect any properties currently listed on the National Register of Historic places. McPhee Reservoir would inundate the townsites of McPhee and Big Ben and about 5 miles of the 1,800-mile route taken by the Dominguez-Escalante expedition in 1776. Construction and operation of the project would directly affect 156 known archaeological sites by investigation and recovery operations completed prior to construction, by damage occurring during construction to sites not salvaged, and by inundation by McPhee Reservoir. A total of 23 sites within the reservoir water line are not recommended for testing and recovery, and these sites would be inaccessible for study or more expensive to study after inundation. Another effect could occur from raised ground water levels resulting from the proposed reservoirs, but the nature of the impacts is little known. An additional 303 known sites would be indirectly affected through increased public access and use of the area, particularly by treasure hunters and vandals. Table C-5 summarizes the number of sites impacted by features, while Attachment 2 contains a more detailed list.

Table C-5
Archaeological sites affected by project features

Feature	Number of sites affected Indirectly	Directly	Totals
McPhee Reservoir	52	75	127
Dolores River Canyon[1/]	33	7	40
Great Cut Dike, Dove Creek, and South Canals	84	3	87
Dove Creek Laterals	105	23	128
Towaoc Canal and Laterals	29	48	77
Totals	303	156	459

[1/] To about 10 miles below the proposed McPhee Dam site.

11. Land Ownership and Use

The rights-of-way for project features, as shown in Table A-15, would total 18,659 acres. About 11,000 acres of private land would be acquired in fee title and become public land used for such project purposes as water storage and conveyance, public recreation, and wildlife habitat. An additional 6,222 acres of land already in public ownership would be used for the same purposes. Easements would be obtained on 1,260 acres of private land, leaving their ownership unchanged but essentially restricting them to their present use. The project would convert 27,860 acres of dry-farmed land and 7,500 acres of uncultivated land to irrigated farming.

12. Scenery

During project construction heavy machinery, increased human activity and scars would temporarily detract from scenery, although they would normally be visible only in local areas. The reservoir basins and dams would be particularly unattractive during clearing and other work before filling occurred. Excavations for canals, pipelines, and other facilities would also create sections of cleared land until vegetation could be reestablished.

The project canals, pumping plants with elevated storage tanks up to 175 feet high, powerlines, and other facilities would alter the landscape over a long period, but in many instances they would be situated in areas already affected by man's presence. The three reservoirs would have varying impacts. McPhee and Monument Creek Reservoirs would be marked by seasonal drawdowns and would expose about 2,300 and 60 acres of foreshores, respectively, during maximum drawdown in the late summer and fall. They could enhance the landscape, however, when full in the early summer and when snow covered the foreshore in the winter. Dawson Draw Reservoir, with a nearly constant water level and a surrounding wildlife area, would provide a pleasant landscape.

The aesthetic improvement of the Dolores River resulting from the continuous streamflows would contribute to the river's appeal as a wild and scenic river, if the river were designated as such. As pointed out in Chapter A, the Departments of Interior and Agriculture and the State of Colorado have recommended that the Dolores River below McPhee Reservoir be included in the Wild and Scenic River System, based on the assumption that the Dolores Project would be built.

13. Economic and Social Conditions

a. Population

Short-term population growth in Montezuma and Dolores Counties could reach 4.5 percent annually during project construction, but following construction the rate would decrease to about 1 percent by the year 2030. Thus, with project development, long-term growth is expected to have an average annual rate of about 1.6 percent, which would be higher than the historical rate of 1.3 percent and the predicted rate of 1.5 percent if the project were not built. Short-term growth would be associated primarily with the influx of construction workers and their families. Long-term growth would result indirectly from the increased economic growth produced by increased farm production and a dependable municipal and industrial water supply. Table C-6 shows the predicted population growth of Montezuma and Dolores Counties with and without the project. As the table shows, the population could reach 40,060 by 2030, or about 2,600 more people than anticipated without the project.

Table C-6
Future population growth of Montezuma and Dolores Counties

	With Dolores Project	Without Dolores Project
1975	16,775	16,775
1980	20,940	17,480
1990	27,940	22,400
2000	27,940	26,100
2010	31,420	29,570
2020	35,930	32,280
2030	40,060	37,460

b. Housing

The population increase of 2,600 people attributable to the project by 2030 would, at an average of 3.2 persons per family, create a need for over 810 new housing units in addition to the 6,500 units which would be required to house the expected population growth even if the project were not constructed. Demands for recreational and seasonal housing would also increase. During construction, mobile homes would meet much of the increased demands, although facilities such as roads and hookups for electric, gas, water and sewer lines would have to be expanded to accomodate any significant growth in the number of mobile homes. In addition to the housing needs to meet population growth, the 45 families displaced by McPhee Reservoir would need housing. It is anticipated that some new houses would be built in the area to accommodate these families and that some houses would be relocated from the reservoir and occupied by the present owners, but some of the families forced to relocate from the reservoir area would probably choose to leave the project area, forcing a change in occupation, friends, and even life style. The project would have no other significant impact on the future need for housing replacements.

c. Community Facilities and Services

(1) General

Impacts on community facilities and services would closely parallel employment trends. While many community facilities and services are adequate for present demands, most are experiencing the impact of current growth trends. The construction of the project would cause present facilities to become inadequate much sooner than they would have without the project. Following construction the general growth trend in the area and the need for new facilities would not be significantly affected by the project in the long-term. Although the area as a whole would not experience a post-construction decline, some isolated incidents of temporary overdevelopment could occur. The relatively long 9-year construction period would tend to minimize these impacts.

(2) Education

Construction of the project should not substantially affect the educational level of the area but could temporarily create a strain on the existing educational facilities. Most of the schools in Dolores County are older structures that are now used at or near their capacities. The schools of Montezuma County are, for the most part, newer buildings with some excess capacity. If 35 percent of those moving into the area during project construction were school-aged children, about 46 new teachers as well as additional classrooms would be needed to meet peak demands.[1/] Following construction this demand would decrease, and predicted growth trends would absorb the added capacity.

(3) Police and Fire Protection

A maximum of 7 new professional police officers would be needed in the area during the project's construction phase to maintain present levels of service, based on a general planning rate of 1.9 positions per 1,000 people. There are no professional fire protection personnel in the area, and the present volunteer units would need to expand to meet expected growth rates with or without the project. In the long-term, the project effects would not be significant since the population increase resulting from the project would only be 2,600 people by the year 2030.

(4) Water and sewage

An additional strain would be placed on water and sewage facilities. Sewage treatment facilities for the city of Cortez have an excess capacity rating and could sustain a substantial amount of population growth. The city's existing municipal water supply is used at near capacity, however, and by 1980 the city would need additional water. Both the sewage and water facilities for the town of Dolores and rural areas must be expanded to meet any future growth. Although the population influx related to project construction would increase the strain on these facilities, only with the project could the area meet the demands of its projected growth. The towns that have requested water have indicated that the temporary strain placed on the facilities due to the construction of the project are out-weighed by the future demands for municipal and industrial water. Some rural areas would improve their sewage and domestic water sources and facilities because of the development of project water. The project funds which would be provided to the town of Dolores to relocate its sewage facilities would result in improved facilities for the town.

[1/] Based on a family size of 3.2 and 30 children per classroom.

(5) Health

Current health manpower and facilities in the project area, as in most rural areas, are below the overall national levels. The influx of construction workers could place a strain on the present capabilities. In the long-term, the predicted increase of 2,600 people resulting from the project operations would also create a need for slightly expanded health services.

d. Employment and Incomes

During the 9-year construction period the project would provide a total of about 6,270 jobs in direct employment, beginning at about 30 jobs in the first year, rising to a maximum of 1,300 in the fourth or fifth year, then gradually declining to 350 in the final year. Although most of the unskilled labor would come from the local area, about 85 percent of the skilled labor would come from outside the area. The construction period would also result in about 4,370 jobs to provide goods and services for those employed directly. This indirect employment, about 95 percent of which would come primarily from the local area, could reach 910 jobs during the peak year of construction. Although it would not cause a large flow of capital into the area, it would act to increase the dispersal of the Federal money made available by construction. Both the direct and indirect job opportunities would reduce seasonal and year-round unemployment, as well as underemployment.

Operation and maintenance would require 20 full-time employees, and additional long-term jobs would result from project irrigation. As pointed out in Chapter A, some of the dry farms in the Dove Creek area have acreage in excess of the amount for which project water could be provided. In order for all the acreage to receive project water, the present owners would be required to dispose of excess land, creating new farm job opportunities for new owners. The irrigated land on the reservation, which would be operated as a unit by the tribe, would provide the Indians with both full-time and seasonal employment for managing, planting, irrigating, and harvesting.

According to current cost estimates and construction scheduling, a total of $178.2 million would be spent over the 9-year construction period. Based on the Bureau of Reclamation's past experience with similar projects, an estimated $71.3 million would be spent on local salaries, rising rapidly from $340,000 in the first year to a peak of approximately $14.7 million in the fourth or fifth year. Local salaries would then decline to $4 million in the final year. Since Cortez serves the area as a local trade center, most of the salaries would be spent in that vicinity. The development of 7,500 acres of irrigated land would have a significant effect by adding a net annual income of nearly $1 million to the incomes of the Ute Mountain Ute Indian Tribe, helping to supplement the nearly depleted tribal funds received for oil, uranium, and gas leases on the reservation. After the conversion to irrigated farming in the Dove Creek area the farmers' net annual incomes would be increased by about $3 million. Farm income should be more consistent than at present since a lack of rainfall now often decreases crop yields and farm incomes. Supplemental irrigation in the Montezuma Valley area would increase net farm incomes.

e. Welfare

By providing both short- and long-term employment for residents of the area, the project should slightly decrease welfare participation. Considering the timing of the project and the expected long-term growth of the area, no significant economic letdown is anticipated after the completion of construction.

f. Industrial Resource Base

(1) Construction

The Dolores Project would affect the construction industry, agriculture, and recreation. During the 9-year construction period, approximately $178.2 million would be spent on construction of the project. Over 40 percent of these expenditures, in labor and construction materials, would be spent within the project area.

(2) Agriculture

(a) General Effects

With irrigation, the farmers in the Dove Creek and Towaoc areas would probably develop the same general beef and dairy enterprises now characteristic of Montezuma Valley. Land utilization would be improved, and livestock numbers and feed production would be increased. Irrigation would generally increase the diversity and flexibility of crop production, so that the farm income would not depend upon the success or failure of just one major crop. With several crops produced, gains in one could balance losses in another during any given year. The increased security thus provided would create a larger incentive for owners to stay on the farm.

Since the available range land is already fully utilized, the additional feeds required for livestock would be produced essentially from the newly irrigated land. It is anticipated that the majority of farms in the Dove Creek area would combine cash crops with the winter feeding of beef calves which would be sold in the spring. Cow-calf operations would also be important. The Towaoc area would also be developed for a combination of cash crops and livestock feeds. Cow-calf operations and winter feeder calves would comprise the most significant agricultural activity.

Most of the irrigated acreage would be utilized to produce alfalfa, pasture, barley, and corn silage, as shown in Table C-7. Pinto beans and wheat would still be cultivated in the Dove Creek area, but in considerably less acreage than under the present dry-farm conditions. Small orchards would be grown in Montezuma Valley and the Dove Creek area, particularly in the southern portion.

Table C-7
Present and projected crop distribution
(percent of area)

	Dove Creek		Montezuma Valley		Towaoc	
	Without project	With project	Without project	With project	Without project	With project
Alfalfa		60	28	52		60
Wheat	19	6		5		6
Malt barley		5	7	14		5
Feed barley		1	2	1		1
Corn silage		6	2	3		6
Beans	69	11		2		11
Rotation pasture		4	58	15		4
Orchard		2	3	2		2
Idle or follow	12					
Farmstead or waste		5		6		5
Grazing					100	

The availability of project water from storage would enable the farmers in the area to improve a number of farm management practices. The increased dependable water supply, the additional use of fertilizer for irrigated crops, and other farm management improvements would result in larger crop yields per acre in all three project areas. Gross agricultural production would be increased by approximately $1,175,000 annually in the Montezuma Valley area, $11,726,000 annyally in the Dove Creek area, and $3,500,000 annually in the Towaoc area, for a project total of $16,401,000 annually. Moreover, secondary growth would also be expected in local business through increased pressure to supply a growing demand for goods and services.

(b) Agricultural Chemicals

The project would significantly increase the total use of pesticides in the area by providing irrigation on 7,500 acres of uncultivated desert and 27,860 acres of dry-farmed land where the current use of pesticides is negligible. Pesticide use on supplemental service land should not increase significantly. Table C-8 shows the expected increases in various types of insecticides and pesticides. The organophosphrous insecticides such as parathion and diazinon generally disappear from the soil within 2 months of application, but aldrin and dieldrin persist longer. Overall, pesticide levels in return flows should not increase significantly as discussed in the water quality section of this chapter.

Table C-8

Estimated annual pesticide use

	Without project	With project	Increase
Insecticides			
Furadon (pints)	5,000	17,446	12,446
Parathion (lbs.)	2,500	8,723	6,223
Guthion (lbs.)	160	1,220	1,060
Diazinon (lbs.)	214	1,628	1,414
Herbicides			
2,4-D (lbs.)	1,084		2,347
Edtam (lbs.)		1,103	1,103
Treflan (lbs.)		1,103	1,103
Atrazine (lbs.)		4,897	4,897

The Federal Environmental Pesticide Control Act of 1972 contains provisions designed to safeguard the environment by registration and classification of pesticides and certification procedures for pesticide applicators. EPA's pesticide registration and certificaiton program will be fully implemented by October 1977. Only fully registered and labeled pesticides would be used by certified applicators on the project, and significant adverse effects on nontarget species are not expected.

The use of fertilizers would not increase significantly in the supplemental service area, but would increase significantly on the Dove Creek and Towaoc lands. Phosphate use would be increased by a total of 2,980 tons and annual nitrogen use would be increased by 2,140 tons. These, however, should not contribute significant amounts to runoff water, as discussed earlier in this chapter.

(3) Recreation

The project would provide recreational facilities and opportunities, accommodating boating, swimming, water skiing, picnicking and camping, fishing, and hunting. These opportunities would affect the area by fulfilling needs for recreation and leisure, stimulating the economy to provide services and goods for recreation users, and increasing pressure on the natural resources of the area such as vegetation, wildlife, and water resources. As Table C-9 shows, annual outdoor recreation use attributed to the project would average about 280,000 man-days.

Table C-9

Anticipated recreation use attributable to the Dolores Project (man-days)

Feature	General recreation
McPhee Reservoir	186,600
Dolores River below McPhee Dam	[1]70,640
Monument Creek Reservoir	22,882
Total	280,122

[1] Includes 1,320 man days of white-water boating.

Fishing opportunities would be created in the three project reservoirs and in the Dolores River below McPhee Dam. Existing opportunities also would be increased in Groundhog Reservoir and in stream sections below the reservoir. The project would also improve hunting opportunities. All three reservoirs would provide waterfowl hunting, and Monument Creek and Dawson Draw Reservoirs would provide upland game hunting as well. Additional opportunities for upland game hunting would be provided by cover and feed habitat planted along the canal rights-of-way. Table C-10 summarizes anticipated increases in hunting and fishing opportunities.

Table C-10
Annual fishing and hunting use
attributable to the Dolores Project
(man-days)

	Fishing		Hunting	
Feature	Without project	With project	Without project	With project
McPhee Reservoir	0	52,000		
Big game (units 71, 72, & 73)			29,100	29,100
Upland game			0	0
Waterfowl			0	500
Wildlife oriented activities			0	10,000
Dolores River below McPhee	0	38,000		
Monument Creek Reservoir	0	1,500		
Upland game			0	300
Waterfowl			0	200
Wildlife oriented activities			0	500
Dawson Draw Reservoir	0	35,000		
Upland game			0	1,500
Waterfowl			0	2,500
Wildlife oriented activities			0	15,000
Groundhog Reservoir	10,000	27,600		
Groundhog Creek	3,000	5,400		
West Dolores River	5,000	9,000		
Dolores River above Dolores	5,000	6,600		
Dove Creek area				
Upland game			300	1,100
Montezuma Valley area				
Upland game			500	1,000
Total	23,000	175,100	29,900	61,700

g. Public Finance and Tax Base

Project development would cause some significant changes in the assessed valuation of the Dove Creek area by changing about 27,860 acres from dry land farming to irrigation. The assessed valuation is projected to increase by more than $10 million by the end of 1990. In addition to this direct effect, increases would occur from the development of raw land for recreational or summer home use, the subdivision of small acreages for homes, the expansion of retail and wholesale trade in the area and the expansion of the services industry. All of these effects would cause an estimated 5 percent annual growth in the tax base from 1978 to 1991. Following the completion of the project development period in 1991, growth is expected to proceed at approximately 4 percent annually as a result of continued inflation as well as continued economic growth in the area. Table C-11 compares the assessed evaluation expected with and without the project through 2030.

Table C-11
Assessed valuation

	With the project	Without the project
1975	$42,491,000	$42,491,000
1978	46,095,000	46,095,000
1980	50,820,000	48,902,000
1990	82,780,000	65,719,000
2000	122,535,000	88,323,000
2010	181,381,000	118,699,000
2020	268,468,000	159,522,000
2030	397,428,000	214,383,000

The land acquired for the project would be removed from the tax rolls, causing a loss in revenues of about $7,000 annually in taxes on private property. This effect is negligible when compared to the significant increase in valuation and taxes of about $625,000 annually derived from the conversion of 27,860 acres to irrigation in the Dove Creek area.

h. Summary

During the construction period, the Dolores Project would provide opportunities for employment among local residents, but the influx of construction workers and their families from the outside would also put additional stress upon municipal and public facilities such as housing, schools, police, and fire protection, health care, water and sewage treatment, and utilities. In the long-term, however, the project would not only supply much needed municipal and industrial water but would also substantially increase tax bases and business opportunities and income, creating, in turn, the economic climate for expansion and improvement of municipal and public facilities.

The agricultural sector of the local population would be provided a reliable irrigation water supply, thus increasing production and permitting crop diversity. The Ute Indian Tribe would be provided a new source of tribal income with the establishment of irrigated agriculture on its lands.

CHAPTER D

MITIGATING MEASURES AND AIR AND WATER QUALITY ASPECTS

D. MITIGATING MEASURES AND AIR AND WATER QUALITY ASPECTS

1. General

This section presents the measures that would be carried out to protect the environment and mitigate adverse effects. The Bureau of Reclamation would comply with the Clean Air Act, the Federal Water Quality Act, the Federal Water Pollution Control Act, the Fish and Wildlife Coordination Act, the laws and executive orders regarding archaeological and historical resources, and other pertinent laws, procedures, and policies.

2. Measures to be Employed During Construction

Construction specifications would be written and construction activities monitored to protect the environment. Contractors would be required to comply with applicable Federal, State, and local laws, orders, and regulations concerning the prevention and control of air and water pollution. Specifications would also require landscape preservation.

a. Air Quality and Noise Control

During construction, measures would be carried out to reduce dust and excessive exhaust pollution. Noise levels would be maintained below 75 decibels at night (8 p.m. to 7 a.m.) and 80 decibels during the day, measured outdoors at residences or other noise-sensitive areas.

b. Water Quality

Construction activities would be performed by methods that would prevent solid matter, debris, and other contaminants from entering streams, lakes, ground water, and other water courses. Such pollutants include refuse, garbage, concrete, sanitary wastes, and petroleum products. Turbidity would be controlled by the use of suitable sedimentation or settling ponds and flocculating agents where necessary. The water quality standards of the State of Colorado would be followed. The construction contractor would be required to obtain permits under the National Pollutant Discharge Elimination System to control the quality of wastewater discharges.

c. Landscape Preservation

Construction camps, shops, offices, and yards would be located and arranged in a manner to preserve soil and vegetation to the maximum extent practicable. At the reservoir sites, these areas would be located within the reservoir basins. Upon abandonment all materials and debris would be removed from the sites, and the construction areas outside the reservoir basins would be reshaped and revegetated with native grasses and trees. The movements of crews and equipment would be restricted to established routes. If temporary roads were necessary, the alignments would be restored. Borrow and riprap areas would be excavated so as not to pond water. Before being abandoned, the sides would be brought to stable slopes and shaped to provide a natural appearance.

d. Other Considerations

If the use of pesticides were necessary, only those registered with the Environmental Protection Agency in compliance with the Federal Environmental Pesticide Control Act of 1972 would be used. Drilling and blasting would be done in compliance with applicable Federal, State, and local safety regulations. To avoid possible adverse effects of human activity on peregrine falcons in the project area, canal construction would be scheduled to avoid conflicts with courtship, nest selection, and incubation (March-June).

3. Measures Incorporated in Project Design and Operation

a. Mitigation of Wildlife Losses

To fully compensate for the loss of wildlife habitat caused by reservoir inundation, 4,150 acres of private and public land west of McPhee Reservoir would be acquired and improved specifically as big game winter range. In addition, wildlife easements would be obtained on 420 acres of private land on the east side of the reservoir.

b. Salvage and Preservation of Archaeological and Historical Sites

The Bureau of Reclamation would comply with specific regulations designed to protect, preserve, restore, and maintain historical, archaeological, and anthropological resources. These regulations are contained in the Reservoir Salvage Act of 1960, Presidental Executive Order 11593, the National Environmental Policy Act of 1969, the Historic Preservation Act of 1966, the Historic Sites Act of 1935, the Antiquities Act of 1906, and Section 8 of the Colorado River Storage Project Act of 1956. The Bureau of Reclamation, with a specific policy to mitigate adverse impacts on historical and archaeological resources, is proceeding with the following program:

(a) Contracting with professional archaeologists to examine the project area and provide inventories of the resources

(b) Evaluating the resources for significance and for eligibility for nomination to the National Register of Historic Places

(c) Nominating for the register any properties deemed eligible

(d) Seeking the advice of the President's Advisory Council on Historic Preservation whenever properties eligible for or already on the Register would be affected

(e) Developing and carrying out specific mitigation programs in coordination with the State Historic Preservation Officer and the Advisory Council on Historic Preservation

After completing, its archeological survey of the proposed Dolores Project rights-of-way, the University of Colorado recommended that the area be nominated to the National Register of Historic Places as an archaeological district. The proposed boundaries of the district would be the town of Cahone and Bradfield Ranch on the north, the eastern boundary of the proposed McPhee Reservoir right-of-way on the east, Mesa Verde National Park and the Ute Mountain Ute Indian Reservation on the south, and U.S. Highway 160 on the west. The nomination forms are being prepared for submission to the State Historic Preservation Officer and the National Register of Historic Places.

As discussed in Chapter A, the Bureau has a proposed archaeological program involving a survey of the remaining area within the rights-of-way followed by an intensive excavation or test excavation of 137 sites and surveillance of all the remaining sites while construction is underway. Intensive excavation would be designed to recover substantial data from a site. Test excavation would involve a limited testing of a site to determine if further investigation would be desirable. A more complete listing of the sites by cultural period is contained in Attachment 2.

Should any previously unrecorded cultural resources sites be located during construction, they would be evaluated by an appropriate professional. A determination would be made in consultation with the State Historic Preservation Officer regarding the eligibility for nomination to the National Register of Historic Places and any eligible sites would be nominated for inclusion in the Register.

The University's survey identified 281 sites that would not be protected by Federal laws and regulations since they would continue to be on private property. The Bureau would encourage the landowners to preserve these sites in the future and would offer technical assistance.

c. Control of Vectors

Various measures would be undertaken as part of project construction and operation for control of vectors. The normal summer fluctuation zones of reservoirs would be completely cleared, except for isolated vegetation along abrupt shorelines that would be exposed to wave action or other places where mosquito production is not likely to occur. Low areas which could form pools at minimum water levels would be connected with the reservoir by channels to ensure drainage during low water levels. Drainage would also be provided for seeped and ponded areas behind dikes where significant mosquito production could occur. In order to ensure unrestricted drainage, vegetation, debris, and flotage would be periodically removed from the control drains.

d. Preservation of Scenery

Roads, borrow and riprap sources, canals, pipelines, and other facilities would be located so as to minimize their visual effects whenever practicable. Design criteria, color, and textures would also be used to help blend features into the surrounding landscape. The elevated steel tanks in the Dove Creek area would be painted with an earth tone, for example, and permanent operation and maintenance buildings would have a low profile.

e. Protection from Hazards

Project features have been designed to minimize hazards. Safety devices along canals, at canal structures, and around the dams would include fences, signs, guardrails, and handrails. Concrete-lined canals would have escape ladders and escape mats for humans and wildlife. Drop-line cables, floats, nets, and trashracks would be placed above the entrances to such canal structures as siphons, drops, tunnels, and road crossings. All buildings, access facilities, and mechanical and electrical facilities would have fences and warning signs.

f. Land Acquisition and Relocation of Families

All land acquisitions and the relocation of displaced individuals would be accomplished according to provisions of the Uniform Relocation Assistance and Real Property Acquisition Act of 1970 and other applicable Federal legislation and regulations. These acts and regulations require the Government to pay an amount determined to be the fair market value based on an approved appraisal procedure. In partial takings, the fair market value includes any loss in value to the remainder property (severance damage). In addition to the payment of just compensation, the landowner would be entitled to compensation for relocation expenses as provided by the above-mentioned Relocation Act. All landowners would be advised of acquisition and relocation procedures and assisted in the preparation of applications for reimbursement of relocation expenses and provided with other services required by that Act.

4. Measures Designed to Control the Overall Salinity Levels in the Colorado River

Salinity increases from the Dolores Project and similar water development projects in the Colorado River Basin are expected to be offset by measures authorized by Title II of the Colorado River Basin Salinity Control Act which outlines the Colorado River Basin Salinity Control Program. The program provides for the construction, operation, and maintenance of four salinity control units as the initial stage of the program. The act also directs the Secretary of the Interior to expidite the investigation, planning, and implementation of other control units throughout the Colorado River Basin. The salinity control program is intended to provide sufficient measures to maintain the salinity of the Colorado River at Imperial Dam at its 1972 level of 879 mg/l, while the Upper Basin continues to develop its compact-apportioned waters.

CHAPTER E

UNAVOIDABLE ADVERSE EFFECTS

E. UNAVOIDABLE ADVERSE EFFECTS

The projected beneficial and adverse environmental impacts associated with the Dolores Project have been discussed in Chapter C. Measures designed to mitigate adverse effects and protect the environment are outlined in Chapter D. This chapter lists the most significant adverse impacts that could not be avoided or fully compensated for.

1. Water Resources

The average annual flows of the Dolores River would be depleted by 105,200 acre-feet, while the Colorado River would be depleted by 80,900 acre-feet downstream from the project return flows. The salt concentration in the Colorado River would be increased by an average of 1.0 mg/l from salt loading and 8.4 mg/l from the project stream depletion as measured at Imperial Dam, thus decreasing the quality of water available for irrigation and municipal and industrial use in the Lower Colorado River basin.

2. Fish and Wildlife

McPhee and Dawson Draw Reservoirs would inundate stream habitat that now supports small populations of nongame fish in 10 miles of the Dolores River, 1 mile of Dry Canyon Creek, 4 miles of Beaver Creek, 1 mile of Plateau Creek, and 1 1/2 miles of Dawson Draw. Maintaining more uniform flows with cooler temperatures and reduced turbidity would also have adverse effects on certain species of nongame fish.

All of the project facilities would remove wildlife habitat. The three proposed reservoirs would inundate a total of 4,848 acres, including 4,447 acres of native vegetation and crop land that now supports wildlife to varying degrees and 401 acres of waste land, streambed, and gravel pits. Associated features such as the Great Cut Pumping Plant, recreation sites, and access roads would remove 350 acres of similar habitat and 20 acres of waste land. The project canals, pipelines, and their access roads would result in an additional loss of 320 acres of native growth and crop land. These losses must be regarded as adverse effects even though the development of wildlife management areas and the seeding of the canal rights-of-way would accommodate many of the displaced numbers of wildlife and compensate for the impacts on total populations of the various species.

Early losses of deer and elk to drowning because of disrupted migration routes at McPhee Reservoir could not be avoided, nor could any losses that might result from increases in traffic and other human activity. Populations of some of the various species of nongame mammals, furbearers, varmints, nongame birds, raptors, reptiles, and amphibians now inhabiting the area would be unavoidably reduced because of net reductions in their habitat.

3. Historical and Archaeological Sites

The project would have unavoidable adverse effects on known archaeological sites. Some of the sites would be tested or excavated before construction, while others would be damaged by construction work. In both cases, the sites would be removed and would not be available for future studies and preservation.

4. Scenery

The project structures could be visually unattractive to some people, as would the exposure of foreshore at McPhee and Monument Creek Reservoirs.

5. Economic and Social Conditions

During the 9-year construction period, the project work force would place strains on local housing, water and sewage systems, and educational, transportation, police, fire, and health facilities. Adverse effects would also occur from the relocation of about 120 people in 45 families living in the McPhee Reservoir area. All of the people would have to find new housing, and some could be forced to leave the area and find new sources of income and establish new life styles. The project would also have an unavoidable adverse effect in removing 1,193 acres of dry crop land and 2,259 acres of irrigated crop land from agricultural production.

CHAPTER F

SHORT- AND LONG-TERM ENVIRONMENTAL USES

F. SHORT- AND LONG-TERM ENVIRONMENTAL USES

This chapter contains a brief discussion of the extent to which the proposed action involves tradeoffs between short-term environmental gains at the expense of long-term losses, and vice versa, and a discussion of the extent to which the proposed action forecloses future options.

1. Short-Term Gains Compared to Long-Term Losses

Over the short-term, Federal funds provided to construct the project would stimulate the local economy and create a number of new job opportunities. The excavation of archaeological sites would result in an immediate and more refined knowledge of the Nation's pre-history.

The forced relocation of the 45 families at McPhee Reservoir could be considered a long-term loss, particularly if any of the families lost landholdings which have passed from one generation to another. Relocation could be difficult for such families because of the deep-felt ties they may hold for the land and its relationship to family continuity. From a preservation standpoint the excavation of archaeological sites could be considered a long-term loss.

2. Short-Term Losses Compared to Long-Term Gains

Over the short-term, the influx of construction workers to the project area would put stress upon a number of the area's services such as housing, schools, medical services, police and fire protection, and public utilities. Construction and clearing within project rights-of-way would temporarily reduce wildlife numbers and increase stream turbidity and sedimentation. In the early years of project operation, return flows would increase the salt load in the Colorado River thus degrading the quality of the water for lower basin users. McPhee Reservoir would intersect traditional deer and elk migratory routes and could result in winter wildlife losses if new migratory routes were not quickly established.

Over the long-term, the water developed by the project would benefit the area's economy by increasing agricultural production and, secondarily, strengthening service-related enterprise which is dependent on the success of agriculture for its survival. The municipal and industrial water provided would satisfy present needs and permit moderate but healthy future growth in the area. McPhee Dam would provide flood protection for downstream landowners. Fishery releases from McPhee Reservoir would create a stream fishery with good public accessibility in the initial section of the Dolores River below McPhee Dam. Reservoir operations in anticipation of snowmelt flows would be managed to benefit white-water boaters. The project reservoirs and recreation facilities would provide a variety of new recreational opportunities for the public. Land acquired and managed for wildlife would create valuable and unthreatened habitat for a variety of wildlife species. The project could have a long-term benefit on archaeological resources through the nomination of a historical district to the National Register of Historic Places. This action would aid in the preservation of archaeological sites not excavated or damaged because of project development.

3. Relationships Between Project Development and Future Options for Resource Development

The fuels, power, manpower, and construction materials required for project construction and operation would not be available for other use. Federal funds committed to the project could not be put to other uses.

The development of a portion of Colorado's allocated share of the water in the Upper Colorado River Basin for the Dolores Project would preclude the development and use of this amount of water for other areas of the State.

The inundation of lands and streams would eliminate any alternative use of these areas. These alternative uses could include wildlife habitat, pasture, crop land, homesites, and recreation. The possibility of spinoff developments would further increase the area in which land use changes occurred.

The inundation of archaeological sites would make their future investigation more difficult and expensive if not impractical.

CHAPTER G

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

G. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

A total of 18,659 acres of land now used primarily for agriculture and fish and wildlife habitat would be acquired for project uses. An estimated 5,221 acres of this land would be irreversibly committed to reservoir storage, canals, roads, and other structures. The remaining 13,438 acres would be committed to such long-term project uses as recreational areas, wildlife management areas, and right-of-way. Although this commitment would not necessarily be irreversible, a restoration to present conditions would be difficult.

The construction materials irretrievably committed to use would include an estimated 5,476,000 cubic yards of soil, sand, gravel, cobble, and riprap needed for dam embankments and an undetermined amount of the same materials needed for canal banks, roadbeds, and other features. An additional 462,000 cubic yards of pervious material and 24,000 cubic yards of topsoil would be committed to the landfill area at the head of McPhee Reservoir. Concrete aggregate would also be needed and would come from the area, but the quantity is undetermined. Cement and manufactured materials imported from other areas would be irretrievably committed to the project features. Construction would involve the consumption of energy in the form of fuels, explosives, and electrical power. After construction, electricity would be consumed, primarily for the pumping plants.

The use of project water would involve an irretrievable depletion of the Lower Colorado River of 80,900 acre-feet each year the project as now planned was in full operation. Water uses could be changed in the future, however.

Archeological resources would be irreversibly disturbed through testing, excavation, or damage during project construction.

The project would irreversibly alter the scenery in local areas by the imposition of man-made structures, excavation scars, and embankment slopes onto the landscape.

CHAPTER H

ALTERNATIVES TO THE PROPOSED PLAN

H. ALTERNATIVES TO THE PROPOSED PLAN

1. General

The Bureau has investigated many alternatives in order to derive a plan that would economically serve the water needs of the area while producing the smallest adverse environmental impact. Many of the alternatives were dismissed after a cursory investigation because of physical reasons, such as geologic risks or insufficient water supplies, or because of economic reasons, such as high construction costs. This chapter discusses the alternatives in terms of (1) modifications of the proposed plan to provide essentially the same benefits, (2) alternative uses of the available water that separately could serve different needs of the project area, and (3) nondevelopment. Table H-1 summarizes the impacts of the alternatives, and Figure H-1 shows the locations of the alternative features.

2. Modifications of Proposed Plan

a. Project Plan at Authorization

(1) Development Plan

Development of the plan as it was at the time of authorization in 1968 would provide irrigation, municipal and industrial water, recreation, fish and wildlife enhancement, flood control, and area redevelopment. The plan would include an average annual water supply of 126,900 acre-feet, consisting of 120,800 acre-feet for irrigation and 6,100 acre-feet for municipal and industrial use (4,900 for Cortez and 1,200 for Dove Creek). A total of 61,000 acres would be irrigated, including 28,660 acres of supplemental service land in the Montezuma Valley area, 30,840 acres of full service land in the Dove Creek area, and 1,500 acres of full service land in the Towaoc area.

McPhee Reservoir, with a total capacity of 364,000 acre-feet, would provide the primary storage and regulation. Open gravity irrigation systems would be used on all project lands, and three secondary storage reservoirs would consequently be required to provide irrigation peaking capacity in the Dove Creek area. A 5,040-acre-foot Monument Creek Reservoir would provide irrigation peaking capacity, as well as municipal and industrial storage for Dove Creek. A 16,400-acre-foot Ruin Canyon Reservoir and a 4,340-acre-foot Cahone Reservoir would also be constructed.

The Dove Creek Canal would receive water from McPhee Reservoir at Great Cut Dike by gravity and would extend 68 miles, providing water for Monument Creek and Cahone Reservoirs. The South Canal would

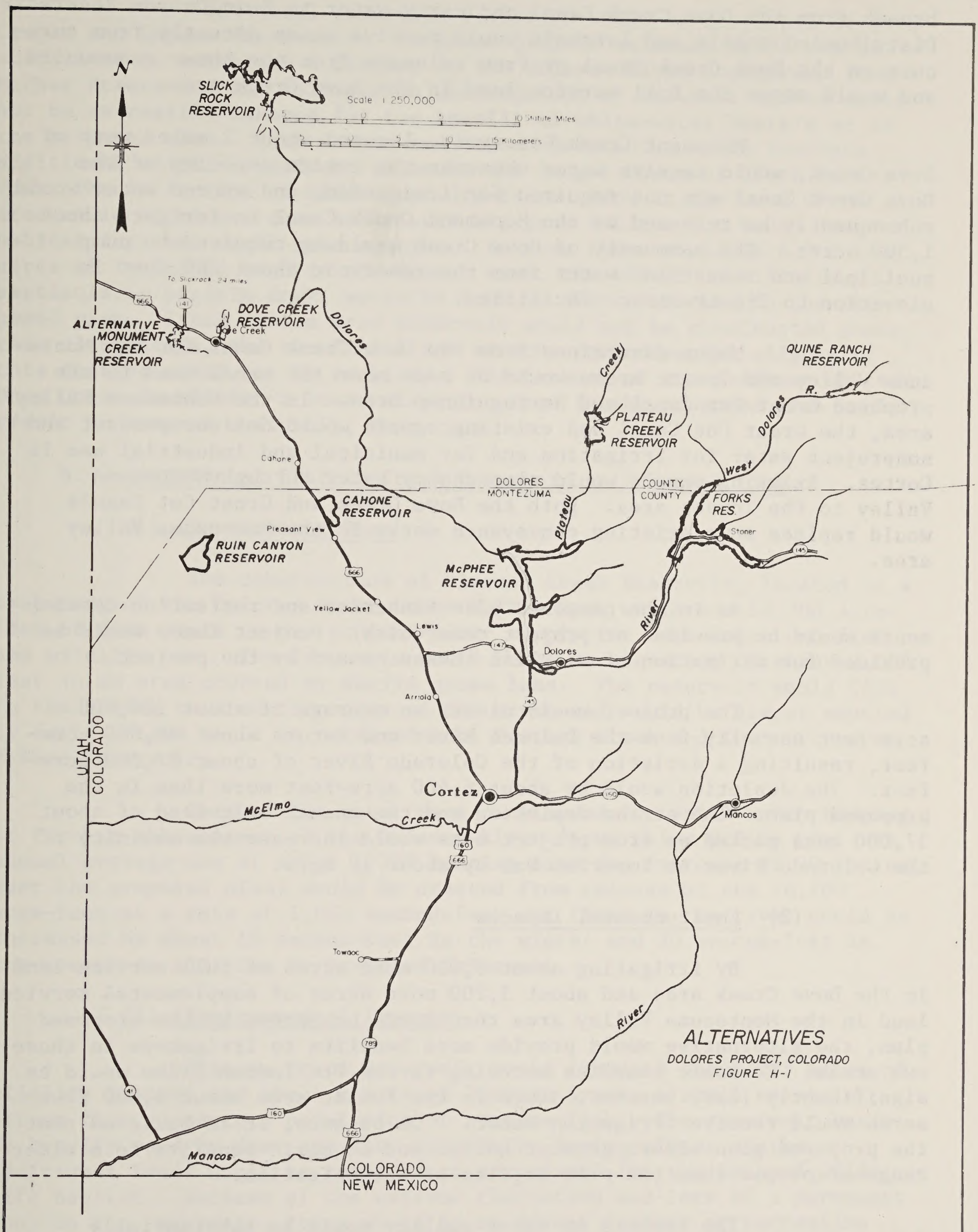
		Alternative uses of water		
	ion	Municipal and industrial only	Stream fishing only	Stream fishing and white-water boating only
Water sup				
Irriga	00			
Munici		8,700		
Recrea				89,300
Fish a			37,300	37,300
T	00	8,700	37,300	126,600
Irrigable				
Full s				
Dov	00			
Tow	00			
Supple				
Vall	00			
T	00			
Environme				
Water				
acre				
Div	00	8,700		
Ret	00	4,350		
Net	00	4,350	6,000	1,200
Fish a				
Hab	icant se	Significant decrease	Insignificant decrease	Insignificant decrease
Fis	ant se	Significant decrease	Insignificant decrease	Insignificant decrease
Scener	pro-	Significant decrease	Insignificant decrease	Insignificant decrease
Constr	icant se	Significant decrease	Significant decrease	Significant decrease
Salini				
Sal	80	1,450		
Eff	.3	0.4		
Effect				
Min			50-35	150-85
Rec			7	7
Recrea				
At				
Bel	le	Negligible	69,320	70,640

1/
2/
3/

Table H-1
Summary of alternatives

	Proposed plan	Modifications of proposed plan				Alternative uses of water			
		Plan at authorization	Proposed plan with Plateau Creek Reservoir	Proposed plan with Slick Rock Reservoir	Proposed plan with Forks Reservoir	Irrigation only	Municipal and industrial only	Stream fishing only	Stream fishing and white-water boating only
Water supply (average annual acre-feet)									
Irrigation	90,900	120,800	90,900	90,900	90,900	126,600			
Municipal and industrial use	8,700	6,100	8,700	8,700	8,700		8,700		
Recreation			10,700	27,800					89,300
Fish and wildlife	27,000		27,000	26,200	27,000			37,300	37,300
Total	126,600	126,900	137,300	153,600	126,600	126,600	8,700	37,300	126,600
Irrigable lands (acres)									
Full service									
Dove Creek area	27,860	30,840	27,860	27,860	27,860	46,100			
Towaoc area	7,500	1,500	7,500	7,500	7,500	7,500			
Supplemental service (Montezuma Valley area)	26,300	28,600	26,300	26,300	26,300	26,300			
Total	61,660	60,940	61,660	61,660	61,660	79,900			
Environmental evaluation									
Water resources (average annual acre-feet)									
Diversion from Dolores River	105,200	126,900	105,200	105,200	105,200	126,600	8,700		
Return flow to San Juan River	25,000	39,600	25,000	25,000	25,000	27,600	4,350		
Net depletion of Colorado River	80,900	87,300	81,300	82,100	80,900	99,000	4,350	6,000	1,200
Fish and wildlife[1]									
Habitat removal		Same as proposal	Insignificant increase	Insignificant increase	Insignificant increase	Insignificant decrease	Significant decrease	Insignificant decrease	Insignificant decrease
Fish and wildlife disturbance		Same as proposal	Insignificant increase	Insignificant increase	Insignificant increase	Significant increase	Significant decrease	Insignificant decrease	Insignificant decrease
Scenery alterations[1]		Significant increase	Insignificant increase	Insignificant increase	Insignificant increase	Same as proposal	Significant decrease	Insignificant decrease	Insignificant decrease
Construction costs[1]		Insignificant difference	Insignificant increase	Insignificant increase	Significant increase	Insignificant increase	Significant decrease	Significant decrease	Significant decrease
Salinity effects									
Salt loading (tons/year)	10,080	37,000	10,080	10,080	10,080	10,080	1,450		
Effect at Imperial Dam (mg/l)[2]	9.4	12.0	9.4	9.5	9.4	11.3	0.4		
Effects on Dolores River below McPhee									
Minimum river flows (second-feet)	50	0	70	50	50			50-35	150-85
Recreation facilities (sites)	7	0	7	7	7			7	7
Recreation days (man days)									
At McPhee Reservoir	186,600	186,600	186,600	186,600					
Below McPhee Reservoir	70,640	Negligible	71,040	71,680	[3] 70,640	Negligible	Negligible	69,320	70,640

[1] Expressed as difference from proposed plan.
[2] Combined effects of depletion and salt loading.
[3] Additional benefits would be realized in Dolores River from Forks Dam site to McPhee Dam site.



ALTERNATIVES
DOLORES PROJECT, COLORADO
FIGURE H-1

branch from the Dove Creek Canal and carry water to Ruin Canyon Reservoir. Distribution canals and laterals would receive water directly from turnouts on the Dove Creek Canal or from releases from the three reservoirs and would serve the full service land in the Dove Creek area.

Monument Creek Reservoir, located about 2 miles west of Dove Creek, would receive water whenever the entire capacity of the Dove Creek Canal was not required for irrigation, and stored water would subsequently be released to the Monument Creek Canal to irrigate about 1,500 acres. The community of Dove Creek would be required to pump municipal and industrial water from the reservoir about 260 feet in elevation to its treatment facilities.

Major diversions from the Dove Creek Canal for the Montezuma Valley and Towaoc areas would be made near the canal head to the proposed Great Cut Canal and Narraguinnep Draw. In the Montezuma Valley area, the Great Cut Canal and existing canals would deliver project and nonproject water for irrigation and for municipal and industrial use in Cortez. Existing canals would also convey water through Montezuma Valley to the Towaoc area. Both the Dove Creek and Great Cut Canals would replace some existing conveyance works in the Montezuma Valley area.

As in the proposed plan fisheries and recreation developments would be provided at project reservoirs. Project funds would be provided for mitigation of wildlife losses caused by the project.

The project would divert an average of about 126,900 acre-feet annually from the Dolores River and return about 39,600 acre-feet, resulting a depletion of the Colorado River of about 87,300 acre-feet. The depletion would be about 6,400 acre-feet more than in the proposed plan. The stream depletion and the annual salt load of about 37,000 tons picked up from project uses would increase the salinity of the Colorado River at Imperial Dam by about 12 mg/l.

(2) Environmental Impacts

By irrigating about 3,000 more acres of full service land in the Dove Creek area and about 3,200 more acres of supplemental service land in the Montezuma Valley area than would be served by the proposed plan, the alternative would provide more benefits to irrigators in those two areas. Economic benefits accruing to the Ute Indian Tribe would be significantly less, however, since in the Towaoc area about 6,000 fewer acres would receive irrigation water. On balance, it is believed that the proposed plan offers greater social and economic benefits to a wider range of people than the plan at time of authorization.

The impacts on water quality would be substantially greater under the feasibility plan than the proposed plan. Because sprinkler systems would not be employed on the full service lands, the annual stream depletion would be about 6,400 acre-feet greater and the salt load in return flows about 26,920 tons greater.

Additional reservoir fisheries would be developed at Ruin Canyon and Cahone Reservoirs. Proposed project releases would not be sufficient to establish a fishery in the Dolores River downstream from McPhee Reservoir, and releases in anticipation of snowmelt inflow could not be as readily managed for the benefit of white-water boaters as in the proposed plan. Ruin Canyon and Cahone Reservoirs would inundate additional wildlife habitat, as would the larger Monument Creek Reservoir. The irrigation of additional dry-farmed land in the Dove Creek area would eliminate some additional big game habitat but would improve habitat for some small game species. Because there would be 6,000 less acres of irrigable land in the Towaoc area, the effect on wildlife, particularly prairie dogs, would be less in that area than in the proposed plan. Since Dawson Draw Reservoir would not be constructed under this alternative, the beneficial and adverse environmental effects of this feature would not be realized. Maintenance of the gradient of the Dove Creek Canal with a lower elevation than in the proposed plan would result in several unsightly, deep cuts.

b. Addition of Plateau Creek Reservoir to Proposed Plan

(1) Development Plan

The construction of Plateau Creek Reservoir, located on a tributary of the Dolores River above McPhee Dam, would add 10,700 acre-feet of firm yield to the project water supply for recreation and fish and wildlife use. The reservoir would be at an elevation of about 7,600 feet in an area covered by native grass land. The reservoir would fill in the spring to a surface area of 275 acres and would be almost emptied by fall. Flows would be released into Plateau Creek and then stored in McPhee Reservoir.

Uses of the water were considered for white-water boating or further enhancement of the Dolores River flows below McPhee Dam. An annual average use of about 1,720 boating days (an increase of 30 percent over the proposed plan) would be created from release of the 10,700 acre-feet at a rate of 1,000 second-feet, or flows in the river could be increased by about 10 second-feet in the winter and 20 second-feet in the summer in addition to proposed releases.

(2) Environmental Impacts

Plateau Creek Reservoir would inundate about 275 acres of wildlife habitat and about a mile of Plateau Creek, a small mountain stream that supports a population of nongame fish. The reservoir basin is heavily used by deer and elk, especially during winter months. Additional lands would be required to compensate for the loss of wildlife habitat. Because of the extreme fluctation and lack of a permanent pool in the reservoir, there would be no direct fishery or recreation value associated with the reservoir. Although some additional fishing and white-water boating benefits could be realized in the Dolores River, the construction and operation costs and the adverse environmental impacts on Plateau Creek would outweigh those benefits.

c. Addition of Slick Rock Reservoir to Proposed Plan

(1) Development Plan

Slick Rock Reservoir would be located about 50 miles downstream from McPhee Dam at an elevation of about 5,500 feet in the Dolores River Canyon. The vegetative cover is primarily pinon and juniper trees. The reservoir would be added to the proposed plan to provide additional white-water boating flows. With a capacity of about 26,000 acre-feet, it would collect flows released at McPhee Dam for the maintenance of flows and a stream fishery, averaging 25,400 acre-feet annually. Releases would be made in the most desirable manner to provide boating for a distance of about 47 river miles. About 13 additional launching days annually would be provided.

(2) Environmental Impacts

The increased costs and the adverse environmental impacts of this alternative appear to far outweigh the 2,360 additional boating days of use provided (an 80 percent increase over the proposed plan). First of all, the location of the reservoir would conflict with wild and scenic river proposals for this reach of the river. Wildlife habitat in the canyon would also be lost by inundation. Several miles of stream fishery within the reservoir site would be replaced by a fluctuating reservoir. Downstream fishery values would also be reduced since all streamflows at this reservoir would be stored for release during the boating season. Because of its highly fluctuating nature (it would be empty most of the year) and its inaccessibility, the reservoir would have very little value as a fishery.

d. Substitution of Forks Reservoir for McPhee Reservoir

(1) Development Plan

Planning studies have identified only one other site on or off the Dolores River for a major storage reservoir that would allow a scale of development comparable to McPhee Reservoir. The site is located about 12 miles upstream from the town of Dolores, just below the confluence of the Dolores River and the West Dolores River. The physical and biological characteristics of the site are quite similar to those at McPhee although the reservoir basin would be located in a relatively steep-walled canyon at about 8,000 feet in elevation. Vegetative growth is slightly more lush than at McPhee because of increased precipitation. Wildlife habitation is very similar, including deer and elk winter range. The Stoner ski area is located within the basin, as is State Highway 145 connecting Dolores and Rico.

Forks Reservoir, with a total capacity of about 270,000 acre-feet forming a maximum water surface of 2,700 acres, would provide about the same average annual water supply as McPhee Reservoir. The inactive capacity would be much smaller, however, resulting in more drastic drawdowns during the irrigation season. Stored water supplies would be released into the river and diverted at the diversion dam of the Montezuma Valley Irrigation Company, which would be rehabilitated. Then the flows would be conveyed in the company's Main Canal No. 2 to the Great Cut Pumping Plant where they would be lifted into the Dove Creek Canal. The Great Cut Canal, beginning near the head of the Dove Creek Canal, would carry water to the Towaoc Canal and the Cortez-Towaoc Pipeline.

All of the other project facilities discussed in the proposed plan would be the same, as would the allocations of water for irrigation, municipal and industrial use, recreation, and fish and wildlife.

(2) Environmental Impacts

The construction of Forks Reservoir would not require the relocation of as many families as would McPhee Reservoir, nor would it probably be as disruptive to as many archaeological sites. It would, however, be substantially more costly, primarily because of the forced highway relocation. It would interfere with a section of the Dolores River which has been included in the Wild and Scenic River proposal, and it would not be as valuable as a recreational resource because of the accessibility problems its steep shores would pose.

From a fish and wildlife standpoint Forks Reservoir would inundate less wildlife habitat, although the reservoir site is heavily used by deer and elk during the critical winter months. Mitigation requirements would be about 1,800 acres less than in the proposed development. The reservoir would inundate productive trout habitat in 7 miles of the Dolores River and 4 miles of the West Dolores River. However, an additional 10 miles of the Dolores River in the proposed McPhee Reservoir site could be rehabilitated into a trout fishery.

3. Alternative Uses of Water

a. Development of Irrigation Water Only

(1) Development Plan

McPhee Reservoir would provide a sufficient water supply to irrigate 79,900 acres if all of the water were allocated for that purpose. This acreage would be obtained by adding 18,240 acres of full service land in the Dove Creek area, bringing its total to 46,100 acres, while keeping the Towaoc area at 7,500 acres and the Montezuma Valley area at 26,300 acres. This alternative would require increased capacities for the Great Cut Pumping Plant, the Dove Creek Canal, and the South Canal, and additional sprinkler pumping plants, laterals, and drains for the Dove Creek area.

Monument Creek Reservoir, Dawson Draw Reservoir, and the Cortez-Towaoc Pipeline would be eliminated since they would not provide irrigation service. Recreation facilities around McPhee Reservoir would be reduced, and those along the Dolores River would probably also be removed from the plan. The construction cost necessary to develop the water resources in this manner would be about 10 to 15 percent higher than the cost of the proposed plan.

(2) Environmental Impacts

By increasing the acreage of full service land, this plan would increase economic benefits to agricultural interests. Project water, however, would not be supplied to satisfy the area's municipal and industrial water needs, thus forcing alternative and perhaps haphazard development to satisfy that need. The use of the resources for irrigation only would also have a greater effect on water quality in the Lower Colorado River Basin than the proposal. Stream depletions and irrigation return flows would be greater, and the salinity of the Lower Colorado River would be increased by over 11 mg/l at Imperial Dam. Without the provision of minimum flows, the river would continue to dry up nearly every year and would necessitate a reevaluation of the wild and scenic river proposal. Recreation opportunities would be diminished by the elimination of Dawson Draw and Monument Creek Reservoirs, the elimination of fishing releases from McPhee Reservoir, and the greater water surface fluctuation in McPhee Reservoir.

The development of an additional 18,240 acres of full service irrigated land in the Dove Creek area would eliminate some big game winter range. Additional habitat for some game and nongame small mammals and birds would be established. The beneficial and adverse effects of Monument Creek and Dawson Draw Reservoirs on fish and wildlife resources would be eliminated. Other impacts on wildlife would be similiar to those in the proposed plan. Under this alternative the fishery potential of about 56 miles of the Dolores River would not be realized as in the proposed development. The quality of the fishery in McPhee Reservoir could be somewhat reduced because of the greater fluctuation of the single purpose reservoir. Overall and at less cost, the proposed plan is responsive to a wider range of public needs and environmental concerns.

b. Development of Municipal and Industrial Water Only

(1) Development Plan

The most economical alternative for meeting the municipal and industrial water needs of the area would be to construct the Quine Ranch Reservoir, located at about 8,500 feet in elevation on the West Dolores River. With a surface area of 175 acres and a total capacity of 7,000 acre-feet, the reservoir would provide an average annual water supply of 6,500 acre-feet for Cortez, 1,000 acre-feet for Towaoc, and 1,200 acre-feet for Dove Creek and rural areas. The stored water would be released into the river, diverted at the facilities of the Montezuma Irrigation Company, and conveyed through the company's existing tunnel in a project pipeline to a treatment plant which would be constructed by the water users. Two project trunk lines, a 21.5-mile pipeline to Cortez and Towaoc and a 31.4-mile pipeline to Dove Creek, would deliver the treated water to existing distribution systems.

(2) Environmental Impacts

While this alternative would satisfy the area's municipal and industrial water needs, it would not strengthen the agricultural base of the area's economy. Flood control would not be provided. The benefits to recreation would be extremely limited with this plan, and the proposed designation of the Dolores River below McPhee Reservoir as a wild and scenic river would probably have to be reevaluated. The impacts upon the area's archaeological resources would be negligible. The use of the resource would have a smaller impact on the water quality of the Lower Colorado River than would the proposed plan. Salinity increases would result from both stream depletions and salt loading but would be minor. The effects of this alternative on fish and wildlife resources would be very small. About 175 acres of wildlife habitat would be inundated by the reservoir as would about a mile of the West Dolores River. A cold-water put-and-take fishery could be developed in Quine Ranch Reservoir.

c. Development of a Stream Fishery Only

(1) Development Plan

This alternative would provide only enough water to improve the Dolores River as a stream fishery. A small McPhee Reservoir, with a total capacity of 30,000 acre-feet and a surface area of 720 acres, would be constructed and would provide an average annual water supply of 37,300 acre-feet. Releases at the dam would produce minimum streamflows of 70 second-feet from May through October and 35 second-feet during the rest of the year.

(2) Environmental Impacts

Under this proposal, the flows of the Dolores River would be restored to essentially pristine conditions, thus benefiting the river as a fishery. The needs of agriculture and municipal and industrial water users would not be served. Flood control and recreation benefits would also be sharply reduced. The salinity of water in the lower Colorado River would remain essentially unchanged. Use of water for a fishery would deplete the river by only 1,200 acre-feet from reservoir evaporation and would contribute no measurable additional salt. Impacts on vegetation and wildlife would be relatively small. About 720 acres of land providing winter range for big game and year-round habitat for other species would be inundated. Increased human activity could also disturb the animals in the area.

d. Development of a Stream Fishery and White-Water Boating

(1) Development Plan

This alternative would be based upon utilizing the entire project water supply of 126,600 acre-feet a year for a stream fishery and white-water boating in the Dolores River below McPhee Dam. The only facilities of the alternative would be McPhee Reservoir and recreation facilities at the reservoir and along the river. The stream fishery would be created by an average annual supply of 37,300 acre-feet, with constant releases of 70 second-feet during the summer and fall (May 15 - October 31) and 35 second-feet during the remainder of the year. White-water boating would be enhanced by a supply of 89,300 acre-feet with constant releases of 1,000 second-feet during spring runoff. About 17,070 boating days of use would be provided on an average annual basis. With the increased flows, the wild and scenic river values would be enhanced. Costs for recreational development at the reservoir and downstream from the dam would be the same as in the proposal.

(2) Environmental Impacts

The alternative would provide benefits for recreation, fish and wildlife, and flood control. It would not, however, meet the local needs for irrigation and municipal and industrial water. This use of the Dolores River would produce smaller economic and social impacts than the proposed plan. Impacts on vegetation, fish, and wildlife would be confined to the Dolores River valley. McPhee Reservoir would inundate about 4,500 acres of winter range for big game and habitat for other species as described for the proposed plan. The reservoir would, however, provide habitat for fish and water-oriented wildlife as in the proposed plan. The Dolores River below McPhee Dam would be generally improved for a variety of wildlife although increased human recreational activities could disturb some species. Fish habitat in the river would be considerably enhanced for cold water game species. The uses of the Dolores River would have little effect on the water quality of the Lower Colorado River. The annual stream depletion, resulting from reservoir evaporation, would amount to only 6,000 acre-feet, as compared to 80,900 acre-feet for the proposed plan, and no salt loading would occur.

4. Nondevelopment

The discussion of nondevelopment is restricted to conditions that would exist without development of a Federal project. Although other entities could potentially develop the water for agriculture or for industrial purposes, the high costs involved render it doubtful that any extensive irrigation developments would be undertaken without government involvement. Financing an irrigation development of any magnitude, however, would be a problem for a small entity and would be a limiting factor for any such attempt. From an environmental standpoint, there would be, in the event of a private development, no assurance of minimum streamflows, inactive reservoir capacity for recreation, public recreation facilities, public access to streams, or mitigation of wildlife habitat losses. Nondevelopment would also affect the proposed wild and scenic river designation below McPhee Dam since the river would continue to dry up nearly every year and the white-water flows would remain uncontrolled and therefore minimally utilized.

Agriculture would probably deteriorate as the slowly growing population placed increasing demands upon the available resources. Water presently used for irrigated farming would be gradually converted to municipal and industrial uses. The chronic late-season irrigation shortages, the continued emigration of youth from the farm, and the increasing age of the farm owners would all contribute to increased pressures on the agricultural economy.

Without the project, losses of wildlife habitat by irrigation or reservoir inundation would be unlikely. Game animals would probably be maintained at or near their present populations, and other species should also remain fairly stable. The fishery in the Dolores River downstream from the town of Dolores would remain in its present condition. It is very unlikely that Dawson Draw Reservoir would be constructed for fish and wildlife purposes.

Tourism and recreation would continue to increase as in the past. The scenic qualities of the area would be unchanged, particularly since non-Federal water developments of any consequence are unlikely. Construction activities similar to project construction activity which would alter the landscape would probably not occur in the near future. Therefore, any dramatic altering of the landscape would be avoided, and project-related impacts on archaeology would not occur.

The population would grow at only a slightly lower rate than with the project, and to support at least part of this growth, municipal and domestic water could be obtained by increased efficiencies of water use and the conversion of some water now used for irrigation. Most of the growth would continue to occur in the vicinity of Cortez.

CHAPTER I

CONSULTATION AND COORDINATION

I. CONSULTATION AND COORDINATION

1. Development of the Proposals

In formulating the proposed plan, the Bureau of Reclamation received planning assistance and evaluations of project purposes and benefits from several Federal agencies, including the Bureau of Indian Affairs, the Bureau of Land Management, the Forest Service, the Corps of Engineers, the Fish and Wildlife Service, the National Park Service, the Bureau of Mines, the Public Health Service, the Bureau of Outdoor Recreation, and the Environmental Protection Agency. State and local agencies have also actively participated in the investigations, including the Colorado Water Conservation Board, the Colorado Division of Wildlife, the Southwestern Water Conservation District, the Dolores Water Conservancy District, the Montezuma Valley Irrigation Company, the Ute Mountain Ute Indian Tribe, and local governments.

2. Preparation of the Draft Environmental Statement

Federal, State, and other agencies and organizations have provided information concerning the present environment and anticipated impacts of the project and recommended possible mitigation and enhancement measures. As another means of contributing to the draft environmental statement, various entities commented on an environmental assessment that was circulated for review by the Bureau of Reclamation in June 1975. Several organizations have provided substantial data under the terms of contracts dealing with the project. The Fish and Wildlife Service conducted an inventory of fish and wildlife on the Ute Mountain Ute Indian Reservation, and the Colorado Division of Wildlife provided a similar study on the rest of the project area. Reports on the flora and on the reptiles and amphibians of the area were prepared by Fort Lewis College. The University of Colorado, under contract with the National Park Service, has reported on the archaeological resources of the area. In addition to these reports, the Bureau of Reclamation has obtained information from the published materials of various agencies.

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ATTACHMENTS

ATTACHMENT 1

Chemical Analyses of Water Samples[1/]

				Concentration			Drinking water standards		
Constituents	Units	Number of samples	Sampling period	Min.	Avg.	Max.	Public health service	Colorado	Number of times exceeded
			DOLORES RIVER AT DOLORES						
Temperature	°F	36	4-69 to 1-75	29.00	44.61	74.00			
Turbidity	FTU	26	4-69 to 1-75	1.20	13.14	111.00			
Conductivity (25°C)	Micro-mho	36	4-69 to 1-75	5.80	334.08	593.00			
Dissolved Oxygen	mg/1	33	4-69 to 1-75	5.10	8.80	11.50			
B.O.D. (5 day)	mg/1	18	9-69 to 1-75	.30	1.22	2.50			
pH	su	35	4-69 to 1-75	7.30	8.17	9.20			
Total dis. solids	mg/1	6	4-74 to 1-75	150.00	257.33	333.00	500	500	0
Ammonia	mg/1	29	4-69 to 1-75		.046	.33			
Nitrite	mg/1	28	4-69 to 1-75		.003	.020			
Nitrate	mg/1	29	4-69 to 1-75		.101	.50	45	45	0
Phosphorus	mg/1	23	4-69 to 1-75		.083	.20			
Total phosphates	mg/1	6	4-74 to 1-75		.045	.24			
Cyanide	mg/1	23	4-69 to 1-75				.02	.01	0
Total hardness	mg/1	27	4-69 to 1-75	64.00	168.44	265.00			
Calcium	mg/1	27	4-69 to 1-75	9.2	51.4	80.0			
Magnesium	mg/1	27	4-69 to 1-75	5.00	9.81	20.00	125		
Sodium	mg/1	27	4-69 to 1-75	2.00	10.89	21.00		125	0
Sodium absorption ratio (SAR)		27	4-69 to 1-75	.10	.367	.70			
Chloride	mg/1	26	4-69 to 1-75	5.00	19.19	62.00	250	250	0
Sulfate	mg/1	28	4-69 to 1-75	14.00	40.57	71.00	250	250	0
Fluoride	mg/1	25	4-69 to 1-75		.260	.70		2.4	0
Arsenic	µg/1	25	4-69 to 1-75		.160	4.0	.05	.01	0
Baron	µg/1	28	4-69 to 1-75		35.36	180.00			
Cadmium	µg/1	24	4-69 to 1-75				.01	.01	0
Chromium	µg/1	25	4-69 to 1-75				.05	.05	0
Copper	µg/1	25	4-69 to 1-75				1.0	1.0	0
Iron	µg/1	26	4-69 to 1-75	50.00	151.54	330.00	.3	.3	2 equaled

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[1/] Storet data from Air and Water Surveillance and Analysis Division, Environmental Protection Agency, Denver, Colorado

ATTACHMENT 1

Chemical Analyses of Water Samples

Constituents	Units	Number of samples	Sampling period	Concentration Min.	Concentration Avg.	Concentration Max.	Drinking water standards: Public health service	Drinking water standards: Colorado	Drinking water standards: Number of times exceeded
Lead	µg/l	25	4-69 to 1-75	0.00	0.00	0.00	.05	.05	0
Manganese	µg/l	21	4-69 to 1-75	0.00	0.00	0.00	.05	.05	
Molybdenum	µg/l	9	2-71 to 1-75	0.00	0.00	0.00			
Silver	µg/l	7	4-69 to 1-75	0.00	0.00	0.00	.05		
Zinc	µg/l	26	4-69 to 1-75	0.00	13.08	140.00	5.0	5.0	0
Mercury	µg/l	4	11-70 to 1-75	0.00	0.125	0.50			
Selenium	µg/l	25	4-69 to 1-75	0.00	0.08	2.00	.05	.01	0
Radioactivity:									
Dissolved alpha	pc/l	4	11-69 to 1-75	8.90	20.70	44.10			
Dissolved beta	pc/l	2	4-69 to 1-75	0.28	5.64	11.00			
DOLORES RIVER AT BEDROCK, COLORADO									
Temperature	°F	143	8-70 to 8-73	32.00	51.80	88.70			
Conductivity		142	8-70 to 8-73	220	984	6000			
Conductivity		51	9-64 to 6-66	215	835	1780			
Dissolved oxygen	mg/l	58	7-72 to 8-73	5.4	9.5	14.1			
pH		51	9-64 to 6-66	7.0	7.8	8.6			
Bicarbonate	mg/l	51	9-64 to 6-66	87	164.7	245			
Calcium	mg/l	51	9-64 to 6-66	30	72	356			
Magnesium	mg/l	51	9-64 to 6-66	4.9	19.4	39			
Sodium	mg/l	51	9-64 to 6-66	6.9	72.9	188			
Potassium	mg/l	51	9-64 to 6-66	1.0	3.8	8.7			
Chloride	mg/l	51	9-64 to 6-66	4.9	90.1	288			
Sulfate	mg/l	51	9-64 to 6-66	26	157.8	916			
Boron	mg/l	1	9-64		200				
*pH	su	208	8-71 to 9-75	7.2	8.0	8.5			
*Temperature	°F	208	8-71 to 9-75	32	52	89			
*Conductivity		208	8-71 to 9-75	201	1106	4470			
*Total dissolved solids	mg/l	208	8-71 to 9-75	3	702	3670			

*Obtained from U.S. Geological Survey information

ATTACHMENT 1

Chemical Analyses of Water Samples

Constituents	Units	Number of samples	Sampling period	Concentration			Drinking water standards		
				Min.	Avg.	Max.	Public health service	Colorado	Number of times exceeded
*Calcium	mg/l	208	8-71 to 9-75	13	81.8	460			
*Magnesium	mg/l	208	8-71 to 9-75	4	25.1	132			
*Sodium	mg/l	208	8-71 to 9-75	1	117	759			
*Potassium	mg/l	208	8-71 to 9-75	.8	6.1	28.2			
*Carbonate	mg/l	208	8-71 to 9-75	2.1	7.34	15.			
*Bicarbonate	mg/l	208	8-71 to 9-75	74	174.71	332			
*Chloride	mg/l	208	8-71 to 9-75	4	150	1169			
*Sulfate	mg/l	208	8-71 to 9-75	14	210.8	2170			
McELMO CREEK WEST OF CORTEZ, COLORADO									
Temperature	°F	46	1-68 to 5-75	32	50.9	81			
Turbidity	FTU	36	3-68 to 5-75	8.4	309.4	2500			
Conductivity	Micromho	45	1-68 to 5-75	290	2817.2	4963			
Dissolved oxygen	mg/l	42	1-68 to 5-75	4.8	7.8	11.1			
B.O.D. (5 day)	mg/l	19	7-68 to 5-75	1.1	2.6	7.0			
pH	su	45	1-68 to 5-75	7.6	8.2	8.9			
* Total dissolved solids	mg/l	183	6-72 to 6-76	1350	2653	4050			
Ammonia	mg/l	33	9-68 to 5-75	.0	.16	1.2			
Nitrite	mg/l	31	11-68 to 5-75	.0	.05	.26			
Nitrate	mg/l	32	9-68 to 5-75	1.0	4.6	17.1			
Phosphorus	mg/l	26	9-68 to 5-73	.0	.30	1.0			
Total phosphates	mg/l	6	4-74 to 5-75	.28	.84	1.6			
Cyanide	mg/l	22	3-68 to 5-75	.0	.000591	.012			
Calcium	mg/l	37	3-68 to 5-75	34.4	330.6	636.8			
Magnesium	mg/l	37	3-68 to 5-75	8.	183.9	380			
Sodium	mg/l	37	3-68 to 5-75	100	236.5	590			
Chloride	mg/l	37	3-68 to 5-75	26	51	94			
Sulfate	mg/l	31	9-68 to 5-75	873	1779.7	2996			
Fluoride	mg/l	22	3-68 to 5-75	.30	.7	1.6			
Arsenic	µg/l	21	3-68 to 5-75	.0	.0	.0			

* Obtained from Geological Survey information.

ATTACHMENT 1

Chemical Analyses of Water Samples

Constituents	Units	Number of samples	Sampling period	Concentration Min.	Concentration Avg.	Concentration Max.	Drinking water standards Public health service	Drinking water standards Colorado	Drinking water standards Number of times exceeded
Boron	µg/l	35	1-68 to 5-75	.0	200	760			
Cadmium	µg/l	33	3-68 to 5-75	.0	.0	.0			
Chromium	µg/l	20	3-68 to 5-75	.0	.0	.0			
Copper	µg/l	20	3-68 to 5-75	.0	.0	.0			
Iron	µg/l	36	3-68 to 5-75	.0	1322.7	42000			
Lead	µg/l	20	3-68 to 5-75	.0	5.1	67			
Manganese	µg/l	35	3-68 to 5-75	.0	60	420			
Molybdenum	µg/l	9	2-71 to 5-75	.0	3.3	15			
Silver	µg/l	9	11-68 to 5-75	.0	.0	.0			
Zinc	µg/l	34	3-68 to 5-75	.0	52.6	800			
Selenium	µg/l	36	1-68 to 5-75	.0	7.41	20			
Radium									
Alpha	pc/l	27	9-68 to 5-75	.0	26.2	101.5			
Beta	pc/l	19	9-69 to 5-75	.4	11.5	29.7			
Mercury	µg/l	4	11-70 to 5-72	.0	.0	.0			
Fecal coliforms	no./ 100 ml.	39	1-68 to 5-75	5.	53722.7	1750000			
Total coliforms	no./ 100 ml.	40	1-68 to 5-75	21	72173	542000			
Sodium absorption ratio	Ratio	37	3-68 to 5-75	1.3	2.95	15			
MANCOS RIVER 3 MILES NORTH OF THE COLORADO-NEW MEXICO STATE LINE									
Temperature	°F	36	1-68 to 5-72	32	51.33	81			
Turbidity	FTU	28	3-68 to 4-72	6.5	238.2	1500			
Conductivity		35	1-68 to 5-72	473	1647	2700			
Dissolved oxygen	mg/l	32	1-68 to 5-72	5.1	7.9	12.1			
B.O.D. (5 day)	mg/l	10	7-68 to 4-72	.60	1.55	2.90			
pH	su	36	1-68 to 5-72	7.50	8.24	9.30			
Phosphorus	mg/l	23	9-68 to 4-74	.05	.10	.6			
Cyanide	mg/l	16	3-68 to 11-74	.0	.0	.0			
Calcium	mg/l	28	3-68 to 4-74	55.6	196.2	648.0			

ATTACHMENT 1

Chemical Analyses of Water Samples

							Drinking water standards		
Constituents	Units	Number of samples	Sampling period	Concentration Min.	Concentration Avg.	Concentration Max.	Public health service	Colorado	Number of times exceeded
Magnesium	mg/l	28	3-68 to 4-74	3.00	92.65	243.00			
Sodium	mg/l	28	3-68 to 4-74	14.00	99.32	166.00			
Sodium absorption ratio		28	3-68 to 4-74	.3	1.5	3.0			
Chloride	mg/l	29	3-68 to 4-74	7	17.86	31			
Sulfate	mg/l	24	9-68 to 4-74	156	877.42	1301			
Total dissolved solids	mg/l	36	1-68 to 11-74	375	1690	2780			
Ammonia	mg/l	25	9-68 to 11-74	.0	.04	.25			
Nitrite	mg/l	24	11-68 to 11-74	.0	.005	.034			
Nitrate	mg/l	25	9-68 to 11-74	.0	.26	1.0			
Total phosphates	mg/l	25	9-68 to 11-74	.0	.15	.030			
Fluoride	mg/l	14	3-68 to 5-72	.45	.094	.6			
Arsenic	µg/l	26	3-68 to 4-72	0	.77	20			
Cadmium	µg/l	15	3-68 to 5-72	0	0	0			
Chromium	µg/l	14	3-68 to 5-72	0	0	0			
Copper	µg/l	14	3-68 to 5-72	0	0	0			
Iron	µg/l	27	3-68 to 5-72	0	170	500			
Lead	µg/l	14	3-68 to 5-72	0	0	0			
Manganese	µg/l	28	3-68 to 5-72	0.0	9.64	170.0			
Molybdenum	µg/l	2	8-71 to 4-72	0	0	0			
Silver	µg/l	8	11-68 to 3-72	0	0	0			
Zinc	µg/l	29	11-68 to 6-72	0	126.55	1600			
Selenium	µg/l	28	1-68 to 5-72	0	1.71	11			
Radium									
Alpha	pc/l	11	3-68 to 3-72	1	14.91	50			
Beta	pc/l	4	9-69 to 5-72	2	9.25	17			
Total coliforms	no./ 100 ml.	32	1-68 to 6-72	2	2297.9	30000			
Fecal coliforms	no./ 100 ml.	30	1-68 to 6-72	2	185.36	2300			
Mercury	µg/l	8	11-70 to 5-72	0		2.0			

Chemical Analyses of Water Samples

Constituents	Units	Number of samples	Sampling period	Concentration Min.	Concentration Avg.	Concentration Max.	Drinking water standards Public health service	Drinking water standards Colorado	Drinking water standards Number of times exceeded
SAN JUAN RIVER NEAR THE COLORADO-NEW MEXICO STATE LINE									
Temperature	°F	44	1-68 to 1-75	32	52.34	82			
Turbidity	FTU	34	3-68 to 1-75	12.3	273.51	2000			
Conductivity	Micromho	44	1-68 to 1-75	285	671.41	1300			
Dissolved oxygen	mg/1	40	1-68 to 1-75	4.40	8.05	13.60			
B.O.D. (5-day)	mg/1	16	2-69 to 1-75	.8	1.9	3.6			
pH	su	43	1-68 to 1-75	7.4	8.18	9.1			
Phosphorus	mg/1	25	9-68 to 5-73	0	.17	.8			
Cyanide	mg/1	21	3-68 to 11-74	0	0	0			
Calcium	mg/1	32	3-68 to 1-75	44.8	94.7	120			
Magnesium	mg/1	32	3-68 to 1-75	5.0	22.0	105.0			
Sodium	mg/1	32	3-68 to 1-75	19.0	51.0	110.0			
Sodium absorption ratio	Ratio	32	3-68 to 1-75	.5	1.3	3.6			
Chloride	mg/1	33	3-68 to 1-75	8	16.4	35			
Sulfate	mg/1	28	9-68 to 1-75	95	202	419			
Total dissolved solids	mg/1	36	1-68 to 1-75	215	518	1075			
Ammonia	mg/1	29	9-68 to 1-75	0	.05	.40			
Nitrite	mg/1	27	11-68 to 1-75	0	.010	.140			
Nitrate	mg/1	30	9-68 to 1-75	0	.75	1.8			
Total phosphates	mg/1	4	4-74 to 1-75	.03	.10	.18			
Fluoride	mg/1	21	3-68 to 1-75	.20	.49	1.10			
Arsenic	µg/1	21	3-68 to 1-75	0	0	0			
Baron	µg/1	24	1-68 to 1-75	0	70	260			
Cadmium	µg/1	31	1-68 to 1-75	0	0	0			
Chromium	µg/1	20	3-68 to 1-75	0	0	0			
Copper	µg/1	20	3-68 to 1-75	0	0	0			
Iron	µg/1	34	3-68 to 1-75	0	239.7	1000			
Lead	µg/1	20	3-68 to 1-75	0	0	0			
Manganese	µg/1	32	3-68 to 1-75	0	.9	30			

Pesticide levels of streams draining the project area
(Unit: mg/1)

Location and date of grab sample	Alpha BHC	Beta BHC	Aldrin	Heptachlor epoxide	Dieldrin	Total DDT	Organic phos- phates	2,4-D 2,4,5-T	PCB
Yellow Jacket Creek at State line, September 27, 1976	0.009	0.002	0.008	0.001	0.001	0.006	ND*	<0.001	<0.001
Mancos River at Highway 666, September 27, 1976	.021	.005	.004	<.001	<.001	.003	ND	< .001	< .001
Navajo Wash at road to Towaoc, September 27, 1976	.011	.002	.004	.001	<.001	.005	ND	< .001	< .001
McElmo Creek at State line, September 27, 1976	.015	.006	.005	.002	.001	.005	ND	< .001	< .001
Alkali Canyon at McElmo Creek, September 27, 1976	.005	.001	.001	.002	<.001	.002	ND	< .001	< .001
San Juan River below McElmo above Montezuma Creek, September 27, 1976	.025	.012	.004	.002	.008	.007	ND	< .001	< .001
Montezuma Creek at Highway 262 crossing, September 27, 1976	.033	.025	.001	.003	.041	.005	ND	< .001	< .001
Recommended EPA limit for public and farmstead water supplies			1	.1	1	50	100	1/20 2/2	

1/ Limit for 2,4-D.
2/ Limit for 2,4,5-T.
ND* Not detected.

Chemical Analyses of Water Samples

Constituents	Units	Number of samples	Sampling period	Concentration Min.	Concentration Avg.	Concentration Max.	Drinking water standards: Public health service	Drinking water standards: Colorado	Drinking water standards: Number of times exceeded
Molybdenum	µg/l	6	2-71 to 1-75	0	2.5	10			
Silver	µg/l	8	11-68 to 11-72	0	0	0			
Zinc	µg/l	32	3-68 to 1-75	0	27	600			
Selenium	µg/l	32	1-68 to 1-75	0	1.5	14			
Radium									
Alpha	pc/l	7	11-68 to 1-75	3	14.5	42			
Beta	pc/l	3	9-69 to 10-72	1	8.3	13			
Total coliforms	no./ 100 ml.	41	1-68 to 1-75	38	10708	49000			
Mercury	µg/l	8	11-70 to 3-72	0	.16	1.2			

Historical and Archeological Resources[1]
Dolores Project

Locations	Cultural Periods and No. of Sites[2]	Predicted Impacts (No. of Sites) No Effect	Predicted Impacts (No. of Sites) Adverse Effect	Recommended Mitigation (No. of Sites) None	Recommended Mitigation (No. of Sites) Flag & Avoid and/or Reroute	Recommended Mitigation (No. of Sites) Test and/or Excavate
McPhee Reservoir						
Within maximum water surface	BM II (2)		2			2
	BM II (4)		4	3		1
	BM III - P I (12)		12	7		5
	BM III - P II (3)		3			3
	P I (12)		12	1		11
	P II (2)		2	1		1
	P I - P II (9)		9	4		5
	P II - P III (1)		1	1		
	Undetermined (12)		12	6		6
Within right-of-way	BM II (1)	1				1
	BM III - P I (20)	18	2	13		7
	BM III - P II (1)	1				1
	P I (7)	4	3	2		5
	P II (11)	8	3	2		9
	P I - P II (9)	7	2	6		3
	P II - P III (1)	1		1		
	Undetermined (18)	12	6	11		7
On or near edge of right-of-way	P II (1)		1			1
	P I - P II (1)		1			1
Subtotal		52	75	58	0	69

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[1] See bibliography on last page of table.

[2] BM = Basketmaker, P = Pueblo.

Locations	Cultural Periods and No. of Sites	Predicted Impacts (No. of Sites)		Recommended Mitigation (No. of sites)		
		No Effect	Adverse Effect	None	Flag & Avoid and/or Reroute	Test and/or Excavate
Dolores River Canyon Below McPhee Dam 3/						
Within right-of-way	BM II - P I (6)	5	1	2		4
	P I (5)	4	1	2		3
	P II (1)	1		1		
	P I - P II (5)	3	2	2		3
	Undetermined (10)	7	3	7		3
On or near edge of right-of-way	BM III - P I (1)	1		1		
	P I (1)	1				1
	P I - P II (1)	1				1
	Undetermined (3)	3		2		1
Outside right-of-way	BM III - P I (2)	2		1		1
	P I (2)	2		1		1
	P II (1)	1		1		
	Undetermined (2)	2		2		
Subtotal		33	7	22	0	18
Great Cut Dike, Dove Creek and South Canals (including Pumping Plants)						
Within Right-of-way	BM III - P I (1)		1			1
	P I - P III (1)		1			1
	Undetermined (1)		1			1

3/ To Williams Draw (about 10 miles below the dam).

Locations	Cultural Periods and No. of Sites	Predicted Impacts (No. of Sites)		Recommended Mitigation (No. of Sites)		
		No Effect	Adverse Effect	None	Flag & Avoid and/or Reroute	Test and/or Excavate
On or near edge of right-of-way	BM III - P I (20)	20		6	7	7
	BM III - P II (2)	2		1		1
	P I (3)	3			3	
	P II (2)	2		1	1	
	P I - P II (2)	2		1	1	
	Historical (1)	1			1	
	Undetermined (7)	7		3		4
Outside right-of-way	BM III (1)	1		1		
	BM III - P I (19)	19		19		
	BM III - P II (4)	4		4		
	BM III - P III (1)	1		1		
	P I (4)	4		4		
	P II (4)	4		4		
	P III (1)	1		1		
	P I - P II (3)	3		3		
	P II - P III (2)	2		2		
	Historical (2)	2		2		
	Undetermined (6)	6		6		
Subtotal		84	3	58	13	16
Dove Creek Area Laterals						
Within right-of-way	BM III - P I (1)		1		1	
	P I (1)		1		1	
	P II (2)		2		1	1
	P I - P II (3)		3	2	1	
	P I - P III (1)		1			1
	P II - P III (3)		3		3	

ATTACHMENT 2

Locations	Cultural Periods and No. of Sites	Predicted Impacts (No. of Sites)		Recommended Mitigation (No. of Sites)		
		No Effect	Adverse Effect	None	Flag & Avoid and/or Reroute	Test and/or Excavate
On or near edge of right-of-way	BM III - P I (3)	1	2		3	
	P I (2)	1	1		2	
	P II (9)	5	4	3	6	
	P III (2)	1	1		2	
	P II - P III (5)	3	2	2	3	
	Historical (1)	1		1		
	Undetermined (5)	3	2		3	2
Outside right-of-way	BM III (1)	1		1		
	BM III - P I (17)	17		3	12	2
	P I (19)	19		4	11	4
	P II (24)	24		6	18	
	P III (2)	2			1	1
	P I - P II (2)	2			2	
	P II - P III (11)	11		2	5	4
	Undetermined (14)	14		7	6	1
Subtotal		105	23	31	80	17
Towaoc Canal and Laterals						
Within right-of-way	P I (1)		1			1
	P II (6)		6			6
	P I - P II (1)		1			1
	P II - P III (2)		2			2
	Undetermined (2)		2			2
On or near edge of right-of-way	BM III - P I (2)		2		2	
	P I (1)		1		1	
	P II (15)		15		15	
	P III (2)		2		2	

ATTACHMENT 2

Locations	Cultural Periods and No. of Sites	Predicted Impacts (No. of Sites)		Recommended Mitigation (No. of Sites)		
		No Effect	Adverse Effect	None	Flag & Avoid and/or Reroute	Test and/or Excavate
	P I - P II (2)		2		2	
	P I - P III (2)		2		2	
	P II - P III (6)	1	5		6	
	Historical	1			1	
	Undetermined (9)	2	7		9	
Outside right-of-way	BM III - P I (1)	1			1	
	P I (2)	2		1	1	
	P II (9)	9		2	5	2
	P III (1)	1		1		
	P I - P II (1)	1				1
	P II - P III (5)	5		1	2	2
	Historical (1)	1			1	
	Undetermined (5)	5		4	1	
Subtotal		29	48	9	51	17
Total		303	156	178	144	137

1/ Sources:

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